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PERU CLIMATE CHANGE COUNTRY STUDY

PERU'S NATIONAL GREENHOUSE GAS INVENTORY

1990

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Lima, July 1996

DISCLAIMER

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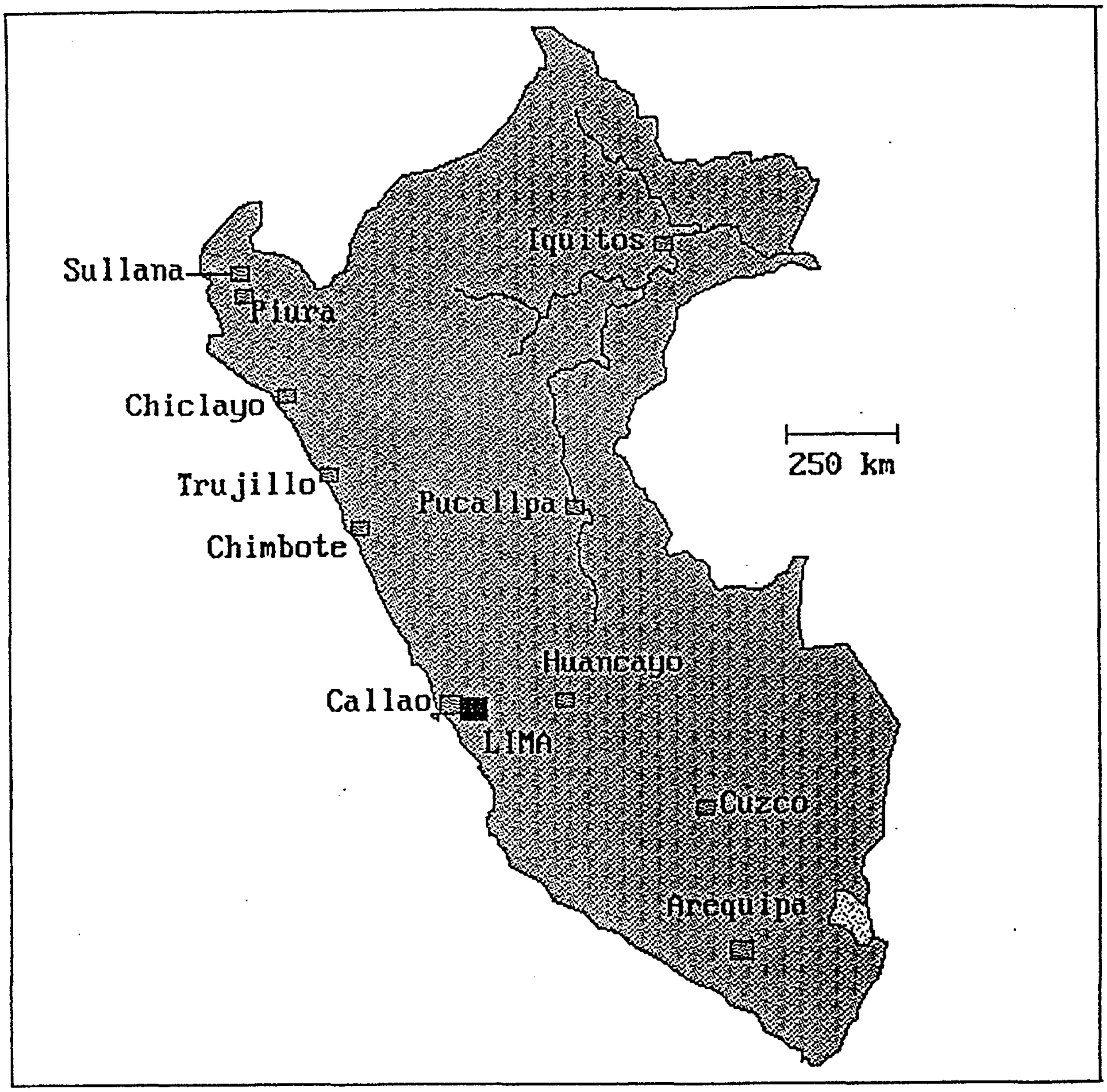
PERU CLIMATE CHANGE COUNTRY STUDY



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EXECUTIVE SUMMARY

Peru has carried out the project "Peru Climate Change Country Study" in association with the United States of America and under the bilateral and cooperative Agreement DEFCO2-94PO1029, developing further inventory and mitigation studies about Greenhouse Gases (GHG) and the Vulnerability of Perus coast.

The aim of this study has been to determine the Inventory and to propose Greenhouse gases mitigation alternatives in order to face the future development of the country in a clean enviromental setting, improving in this way the Peruvian standard of life.
The main objective of this executive summary is to show concisely the results of the National Inventory about Greenhouse Gases emitted by Peru in 1990.

In order to achieve efficiency and organizational purposes , the present study has been divided into: Element I "Energy Sector", Element II "Non energy Sector", Element III "Vulnerability Studies of the Peruvian Coast". The studies about the national total emissions in 1990 are shown in this summary.

In accordance with the bilateral agreement with the United States - cofinancing agent of this project and in the frame of the convention about Climate Change of the UNO carried out in Rio de Janeiro in 1992, 1990 was established as the base year.

TOTAL EMISSIONS OF GREENHOUSE GASES IN 1990

The gases quantified in the present study are: Carbon dioxide (CO_2), Methane (CH_4) and Nitrous Oxide (N_2O). These are the most important Greenhouse gases. To determine CO_2 emissions in the energy sector, the following aspects have been considered:

- Fossil fuel consumption by sectors of final energy demand.
- Biomass consumption as fuel.
- Fuel consumption in the conversion system of primary fuels into secondary ones as well as non energy products (lubricants and oils)
- Electricity generation by fossil fuels and biomass plants.

Methane emissions has been determined from the biomass consumption, charcoal production as well as those that come from natural gas systems and crude oil. Nitrous oxide has only been determined for biomass consumption such as fuel.

The activities referred to in this study as "non energy system" contribute to the Greenhouse Gases total emission. These activities have been divided into; industrial Processes, Agriculture and Cattle, Land use and residuals change.

Table ES-1 shows total emissions of the country. In the Energy Sector, biomass consumption has not been considered as an energy resource (1) in the emission of Carbon Dioxide (CO_2). Although, the emissions of nitrous oxide (N_2O) and Methane (CH_4) shown in table ES-1 are the results of biomass consumption in such sector.

EMISSION OF GASES : CO_2, N_2O AND CH_4 FOR 1990
UNITS : Gg

SECTORS	Greehouse Gases Emission		
	CO_2	N_2O *	CH_4
ENERGY			
EXTRACTION, TRANSMISION AND TRANSPORTATION	----	----	22.46
Coal	----	----	1.95
Oil and Natural Gas	----	----	20.51
CONVERSION	4,299.95	0.04	71.10
Own Consumption	1523.98	----	----
Process **	221.90	----	69.91
Electric Generation	2564.07	0.04	1.19
END USE SECTORS	15,299.28	0.65	86.98
Residential/Commercial	2658.71	0.47	73.01
Public	855.28	----	----
Transportation	7231.58	----	----
Agriculture Cattle/Agriculture Industry	283.15	0.10	3.23
Fishing	655.32	----	----
Industry	2373.28	0.08	10.74
Mining	1242.02	----	----
Emission of Energy Sector	19,599.23	0.69	180.54
NON ENERGY			
Industrial Process	1089.22	----	----
Cement	1089.22	----	----
Agriculture and Cattle	----	3.15	680.92
Enteric Fermentacition	----	---	366.45
Animals Manure	----	---	16.29
Rice Cultivation	----	----	129.80
Nitrogenous Fertilizers Use	----	1.01	----
Field Burning of Agric. Residues	----	0.12	4.81
Savanna Burning	----	2.02	163.57
Foreestry and Land-Use Change	83132.41	3.03	440.78
Forest Clearing	130112.69	3.03	440.78
Conversion of Grassland to Agriculture Land	3062.4	----	----
Abandonment of Managed Lands	- 49714.87	----	----
Managed Forestry	- 327.81	----	----
Wastes	----	----	130.26
Landfills	----	----	28.93
Open Landfills	----	----	70.12
Municipal Wastewater	----	----	4.43
Industrial Wastewater	----	----	26.78
Emission of Non Energy Sector	84221.63	6.18	1251.96
TOTAL EMISSION	103820.86	6.87	1432.50

* Emission due only to biomass consumption in the energy sector.
** Oil and Gas refineries, Charcoal Plants, Coke Plants and Blast furnace are included.

Table ES-1 National emission of greenhouse gases in 1990. In the energy sector, the consumption biomass has not been considered for CO_2 emission.

In the case Peru, we have the consumption of fossil fuel and biomass, accounting the last one an important percentage, mainly wood which is used by the Rural Residential Sector to meet cooking needs. Table ES-2 shows CO_2 emissions resulting from biomass consumption.

NATIONAL CO_2 EMISSION DUE TO BIOMASS CONSUMPTION
UNITS : Gg

ENERGY SECTOR		CO_2
DEMANDING SECTORS OF ENERGY	Residential/Commercial	12540.75
	Agriculture and Cattle/Agriculture Industry	496.19
	Industry	1775.51
	Process ***	742.02
	Electric Generation	183.38
TOTAL		15737.85

*** Charcoal Plants are Included.

Table ES-2 National CO_2 emission due to biomass consumption in the energy sector for 1990.

In the non Energy Sector, Carbon sequestration due to abandoned agricultural lands and forest management has been estimated. These estimates do not compensate the emissions of the forest clearing. As a consequence the emissions resulting from biomass consumption as an energy resource (table ES-2) are part of the total emisssions of the country. Table ES-3 shows concisely the national total emission icluding the biomass consumption in the energy sector for 1990.

TOTAL NATIONAL EMISSION OF CO_2, N_2O AND CH_4
UNITS : Gg

	Greenhouse Gases Emission		
	CO_2	N_2O *	CH_4
ENERGY SECTOR	35337.17	0.69	180.54
NON ENERGETICO SECTOR	84221.63	6.18	1251.96
TOTAL NACIONAL	119558.80	6.87	1432.50

* In the energy sector, these emission result only from biomass consumption.

Table ES-3 Total Greenhouse emission of the country for 1990.

ENERGY SECTOR

The sector referred as "Energy Sector" is the one that includes all the human activities in which energy resources are used and consumed as fuels. We have used the worlwide accepted sectorial division to refer such activities: Energy resource Extraction, Conversion (Primary fuels conversion Process into secondary ones and Electricity Generation) and the Energy demand Sectors (Industrial, Transportation, Residential/ Commercial, Agricultural, Fishing, Mining, etc).

Table ES-4 presents the consumption of liquid, gas and solid fuels as well as the CO_2 emissions of the Energy Sector.

NATIONAL CO_2 EMISSION INVENTORY FOR THE ENERGY SECTOR

FUEL		CONSUMPTION (KTOE)	EMISSIÓN CO_2 (Gg)
LIQUIDS			
CRUDE OIL'S PRODUCTS	CRUDE OIL	49.04	149.06
	GASOLINE	1243.29	3571.27
	KEROSENE	692.81	2063.76
	JET FUEL	197.07	584.04
	RESIDUAL	1607.55	5155.08
	LPG	188.80	493.54
	LUBRICANTS	19.65	59.73
	REFINERY GAS	68.63	190.79
	DIESEL OIL	1857.26	5701.81
SUBTOTAL		5924.10	17968.13
GASEOUS			
GAS	DISTRIBUTED GAS	496.77	1153.39
SUBTOTAL		496.77	1153.39
SOLIDS			
COAL AND HIS TRANSFORMATIONS	COAL	66.80	259.28
	COKE	40.61	180.23
	INDUSTRIAL GAS	16.35	38.21
BIOMASS	WOOD	3391.92	13545.33
	DUNG	259.50	1012.51
	BAGASSE	168.24	679.57
	CHARCOAL	123.90	500.47
SUBTOTAL		4067.32	16215.58
TOTAL		10488.19	35337.17

Table ES-4 Fuels consumption and total CO_2 emission of the energy sector for 1990.

Crude oil consumption shown in table ES-4 represents the loss in refinery process or refinery efficiency. In the present study, this los has been considered as consumption with the aim to achieve a consistent energy balance in refineries process of crude oil with respect to charcoal. The emissions resulting from coke and natural gas consumption have been assigned to these resources, because they are products from their transformation. Figure ES-1 shows the percentage contribution of emission according to each type of fuel used in the energy sector. We can observe that CO_2 emissions due to biomass has an important contribution, because the Peruvian Rural Population use this resource to meet cooking needs and it presents a low efficiency and high CO_2 emission.

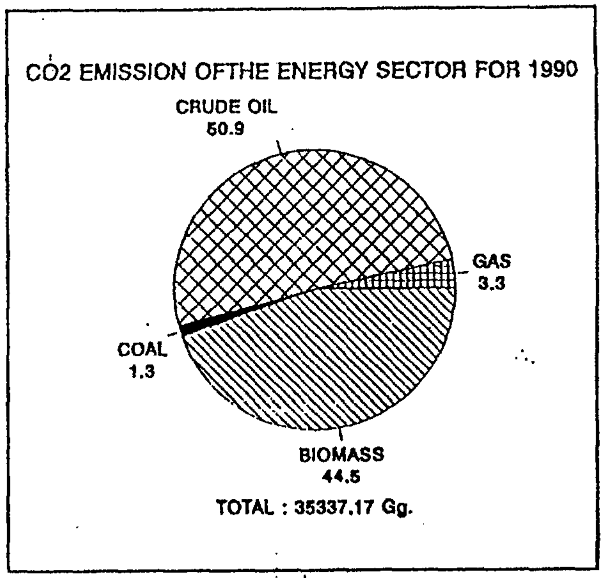

Fig. ES-1 CO_2 percentage emission due to fuels used in the energy sector.

From figure ES-1 we can observe, that the most important energy resources in Peru are: oil and biomass accounting 95.4% of the total emissions of the energy sector.

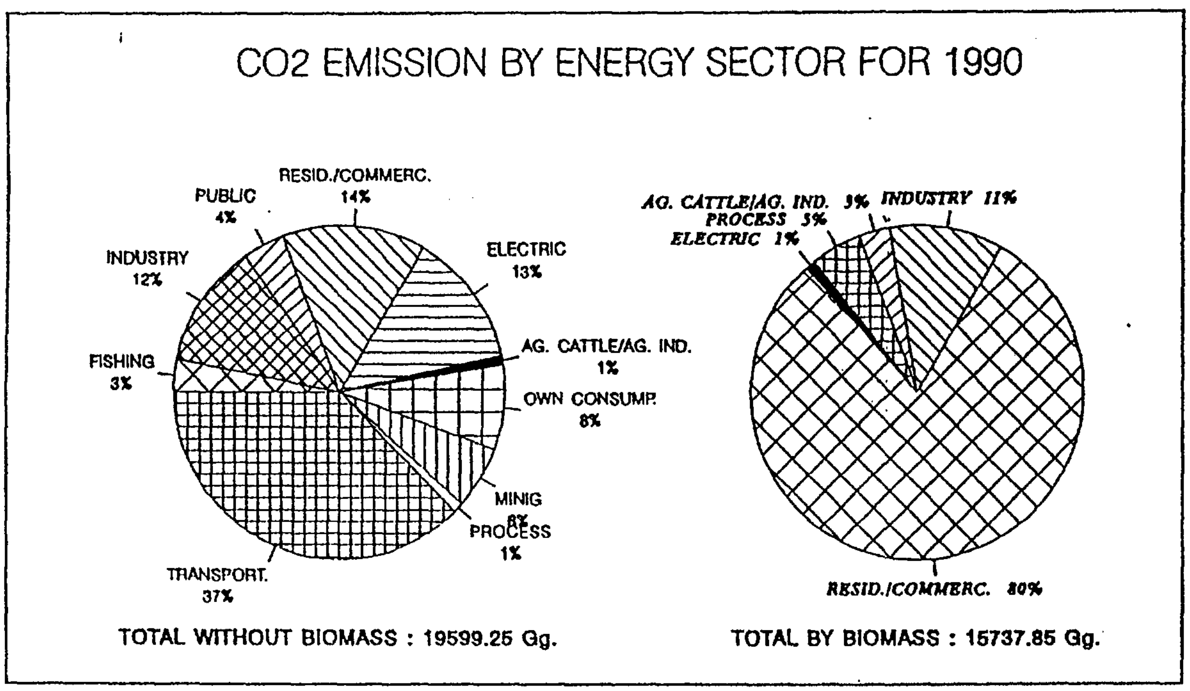

Fig. ES-2 CO_2 emission from the energy demand sectors with and witout biomass.

In figure ES-2, we can observe that, among the Energy demand Sector, without considering biomass, the transportation sector is the major emitter, accounting 37% of the total emission following by the Residential Commercial with 14% and the Industrial with 12%. In respect to biomass emissions , the Residential Commercial Sector has the major importance accounting 80% of the total emission followed by the Industrial Sector with 11%. This is due to the fact that the Rural Population use mainly biomass (wood and dung) to meet cooking, heating and air conditioning needs as well as to heat water. The Industrial Sector use biomass (wood) in food transformation activities.

CONVERSION

This activity includes the fuel consumption required for the conversion of primary energy resources into secondary ones as well as for other needs. In the present study, this type of consumption is referred as "Process Own Consumption"; Fuel consumption in fuel conversion processes (lost or efficiency) is referred as "Processes" and Fuel consumption required to generate electricity is reffered as "Electricity Generation".

FUEL CONSUMPTION AND CO_2 EMISSION FROM THE CONVERSION ACTIVITY

	(kTOE)	Gg of CO_2
OWN CONSUMPTION	586.26	1523.98
PROCESS	251.64	963.91
ELECTRIC GENERATION	880.49	2737.45
TOTAL	1718.39	5226.34

Table ES-5 Fuel consumption and CO_2 emission from the different conversion activities.

Table ES-5 shows CO_2 consumption and emission of the conversion sector.

Figure ES-3 shows CO_2 emissions from the Own consumption Sector, Electricity processes and Generation. All of these emission have been estimated according to the consumption of the different fuels used in these activities. Electricity Generation is the major emitter accounting 52% of the total emission of the conversion activity (2737.45 Gg of CO_2).

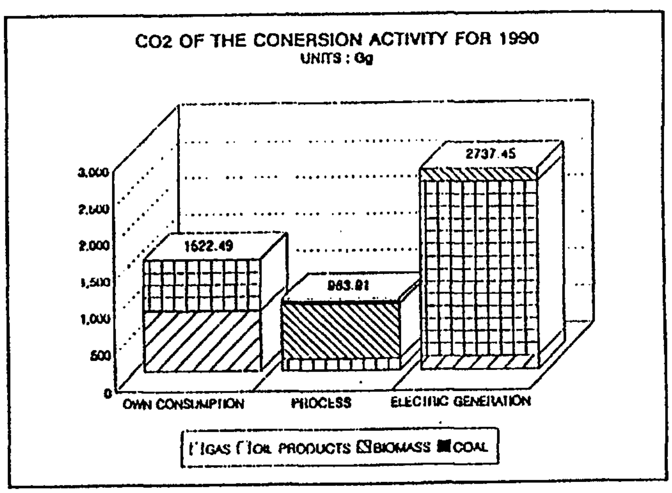

Fig. ES-3 CO_2 emission from the different conversion activities.

TRANSPORTATION SECTOR

In Peru, transportation is accomplished by three ways: by air, land and sea. We have people and load transportation. Although in the present study, these ways of transportation have not been considered because of the lack of statistical data about them. The transportation by air, train and sea have been quantified in a general form.

The type and consumption of fuel according to each type of transportation have been identified and quantified. The age of vehicles of the automovile inventory has been determined.

CO_2 EMISSION IN THE TRANSPORTATION SECTOR

NATIONAL		
TYPES OF FUELS	(kTOE)	Gg of CO_2
GASOLINE	1148.38	3298.65
JET FUEL	137.10	406.31
DIESEL OIL	1033.16	3171.81
RESIDUAL	99.99	320.65
LUBRICANTS	11.34	34.13
TOTAL NATIONAL	2436.98	7231.56
INTERNATIONAL (OIL BUNKERS)		
AVIATION GASOLINE	0.02	0.06
JET FUEL	84.06	249.12
DIESEL OIL	2.04	6.26
RESIDUAL	0.42	1.31
TOTAL OIL BUNKERS	86.53	256.76

Table ES-6 CO_2 Emission due to energy and non energy products combustion in the transportation sector.

Table ES-6 presents the fuel consumption and CO_2 emissions for the transportation sector for 1990. The National and international consumption (oil bunkers) with their CO_2 emission have been quantified. Figure ES-4 shows the percentage contribution of CO_2 emission for each type of fuel consumed by the country and International Transportation. In this sector, gasoline and diesel have great importance accounting 89.5% of total national emission. These fuels are mainly used in roadway transportation.

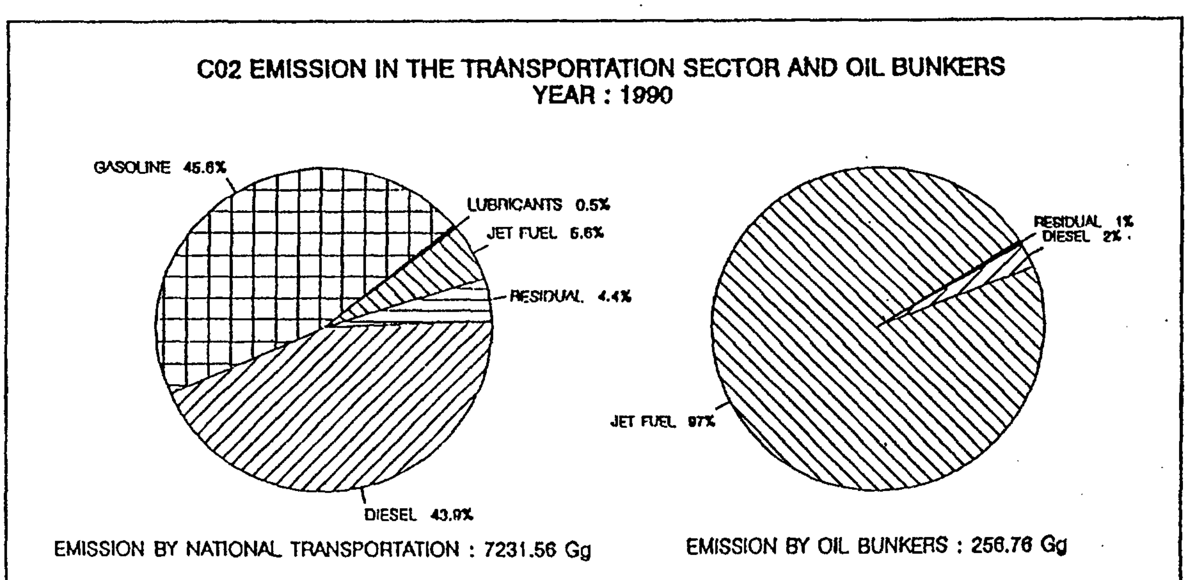

Fig. ES-4 National CO_2 emission from the transportation sector for 1990.

INDUSTRIAL SECTOR

The industrial sector is divided into the following industries: food, drinks and tobaco industry (CIIU31), textil industry (CIIU 32), wood industry (CIIU33), paper industry (CIIU 34), chemical industry (CIIU35), non metal industry (CIIU36), metal industry (CIIU 37), metal products industry (CIIU 38), other manufacturing industries (CIIU 39).

In this sector we have only considered the emission from fuel consumption in the different industrial activities. Figure ES-5 shows the percentage emissions from each industrial activity and from the consumption of the different fuels used by the industrial sector such as petroleum products, gas, charcoal and biomass. It can be observed that the Peruvian industry has an important use of biomass. Food, drink and tobaco industry is the major emitter accounting 54.1% of the total emission of the industrial sector. Therefore, petroleum products and biomass are the major used fuels. Biomass (wood) is mainly used in bread industry in the Rural Residential Sector. Petroleum products are mainly used in mining and metallurgy.

FUEL CONSUMPTION AND CO_2 EMISSION OF THE INDUSTRIAL SECTOR

Fuels/SubSectors	(kTOE)	Gg of CO_2
Foods, Drinks and Tabacco	591.62	2242.88
Textile Industry	67.54	214.40
Wood Industry	1.40	4.25
Paper Industry	116.43	372.06
Chemical Process Industry	88.47	257.47
Non-metalic Minerals Industry	221.49	711.06
Basic Metallic Industry	102.28	346.26
Metallic Products Industry	0.14	0.42
TOTAL	1189.36	4148.80

Table ES-7 Fuel consumption and CO2 emission from the different industrial activities for 1990.

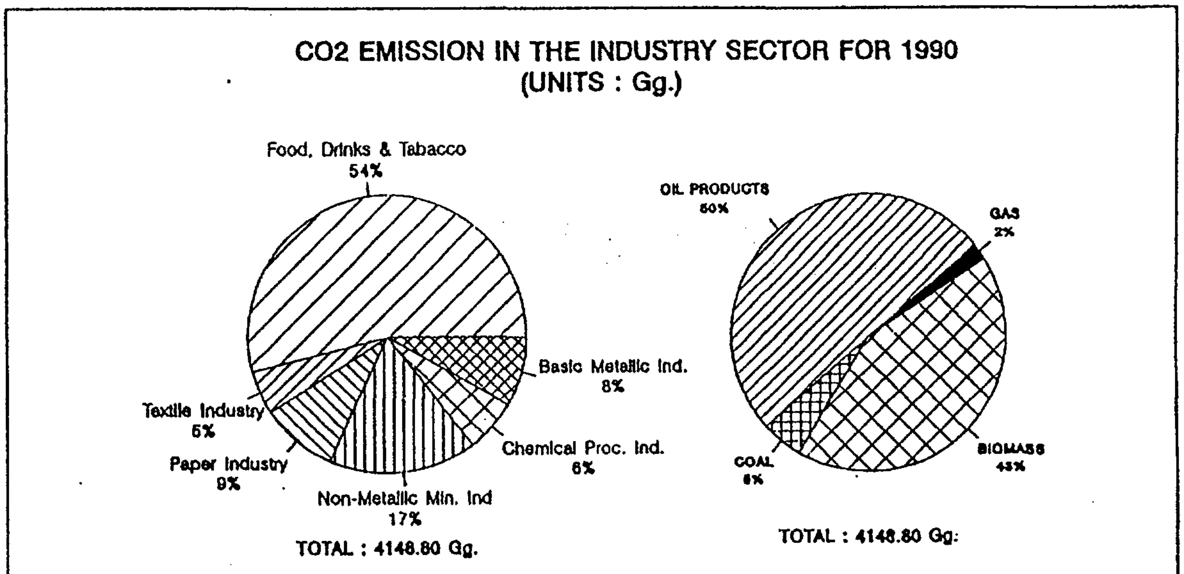

Fig. ES-5 Percentage CO_2 emission from the different industrial activities and from the different fuels used.

OTHER USES SECTOR

This sector was considered in the execution of the PCS project for the inventory. It includes the energy demand of the following sectors: Residential/ Commercial, Public Services, Mining, Fishing, Agricultural and Catttle, Agricultural Industry.

Greenhouse emissions due to fuel consumption from the activities carried out by the Urban and Rural Population have been considered in the Residential/ Commercial Subsector. In this sector, fuel consumption is used to meet cooking, air conditioning, lighting and water and heating needs.

GHG's emissions due to fuel consumption by the govermental institutions in their activities have been considered in the Public Services Subsector.

FUEL CONSUMPTION AND GREENHOUSE GASES EMISSION BY THE OTHER USES SECTOR

	(KTOE)	Gg of CO_2	Gg of CH_4	Gg of N_2O
Residential/Commer.	4068.17	15199.46	73.09	0.47
Publics Services	284.42	855.26	---	---
Mining	379.66	1242.02	---	---
Fishing	206.09	655.32	----	---
Ag. Cattle/Ag. Ind.	212.22	779.34	3.23	0.10
TOTAL	5150.56	18731.40	76.32	0.57

Table ES-8 Fuel consumption and greenhouse gases emission by the others uses sector.

The GHG's emissions due to energy consumption in mining and industrial activities, except non metallurgy, have been considered in the mining Metallurgy Subsector. We have mixed one primary activity such as Mining with a secondary one like metal refineries due to the fact that, both activities conform one economical unity.

The fishing subsector is an economical activity that presents a fluctuating paricipation in the GDP. Although, this subsector presents great perspectives of development in the future. Fuel consumption used in the extraction process and fish transformation have been considered in this subsector.

Fuel consumption from the agriculture and cattle activity and its derived industries have been considered in the Agriculture and cattle-Agricultural industry Subsector. In this case, the consumption from agricultural activities is lower than the agro industrial ones. However, this subsector is directly affected by sugar industrial activities which constitutes an important agent for Peru. Nowadays the consumption is lower, although this sector is an important one, because 30% of the population depends on it. There are plans aimed at its development.

Table ES-8 shows the fuel consumption and the CO_2 emission in the sector refered as "Other Uses". Figure ES-6 shows the CO_2 emission by subsectors and liquid, gas and solid fuels. It can be noted that biomass consumption is the most important fuel, specially wood which is used by the Residential and Commercial Subsector.

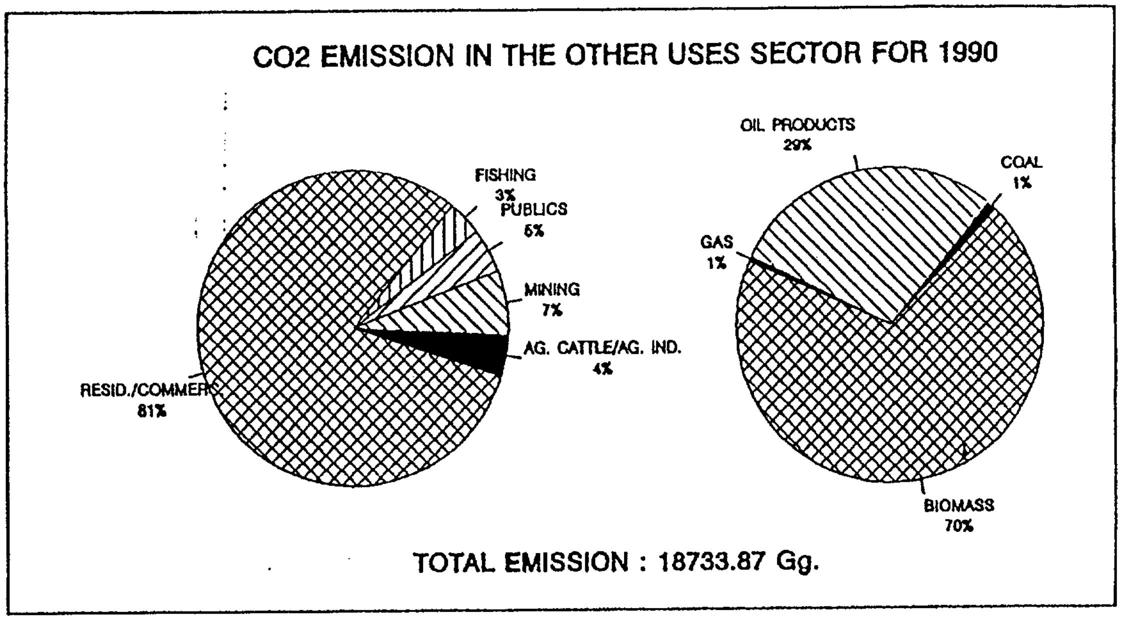

Fig. ES-6 CO_2 emission in the Other uses sector by subsectors and type of fuels used by each of them.

NON ENERGY SECTOR

The emissions from the Industrial processes, Agriculture and Cattle activities, land use change activities and residues are quantified in this part of the inventory refered as: "Non energy Sector".

Table ES-9 shows the emission of the CO_2, N_2O and CH_4 gases of this sector for 1990.

EMISSION OF THE GASES CO_2, N_2O AND CH_4 FROM THE NON ENERGY
UNITS : Gg

AREAS OR EMISSION SOURCES	Greenhouse Gases Emissions		
	CO_2	N_2O	CH_4
Industrial Process	1089.22	----	----
Cement	1089.22	----	----
Agriculture and Cattle	----	3.15	680.92
Enteric Fermentation	----	---	366.45
Animals Manure	----	---	16.29
Rices Cultivations	----	----	129.80
Nitrogenous Fertilizers Use	----	1.01	----
Field Burning of Agric. Residues	----	0.12	4.81
Savanna Burning	----	2.02	163.57
Forestry and Land-Use Change	83132.41	3.03	440.78
Forest Clearing	130112.69	3.03	440.78
Conversion of Grassland to Cultivate Land	3062.4	----	----
Abandonment of Managed Lands	- 49714.87	----	----
Forest management	- 327.81	----	----
Wastes	----	----	130.26
Landfills	----	----	28.93
Open dumping	----	----	70.12
Municipal Wastewater	----	----	4.43
Industrial Wastewater	----	----	26.78
TOTAL	84221.63	6.18	1251.96

(-) Absorption of CO_2.

Table ES-9 National greenhouse gases emission of the non energy sector for 1990.

From table ES-9 we can observe that land use change activities and forestry are great CO_2 emitter sources accounting 98.7% of the total CO_2 emissions in the Non energy sector.

The activities that generate this important CO_2 emissions are : forest clearing and the conversion of pastures into agricultural land which emit 130112.69 Gg and 3062.40 Gg respectively. At the same time, the activities such as abandoned cultivated lands and forests management constitute sinks, absorbing 49714.87 Gg and 327.81 Gg of CO_2 respectively. As a result, a total emission of 83132.41 Gg is achieved.

Figure ES-7 shows the CO_2 emission and absorption in the land use change area. It can be observed that the high rate of the Peruvian jungle forest clearing is the most important in the emission of carbon dioxide. The lack of a reforestation program indicates the low carbon capture, as a result a total and imporatnt emission of CO_2 is observed. Reforestation is basically produced because of the abandonement of lands in which grow a new forest.

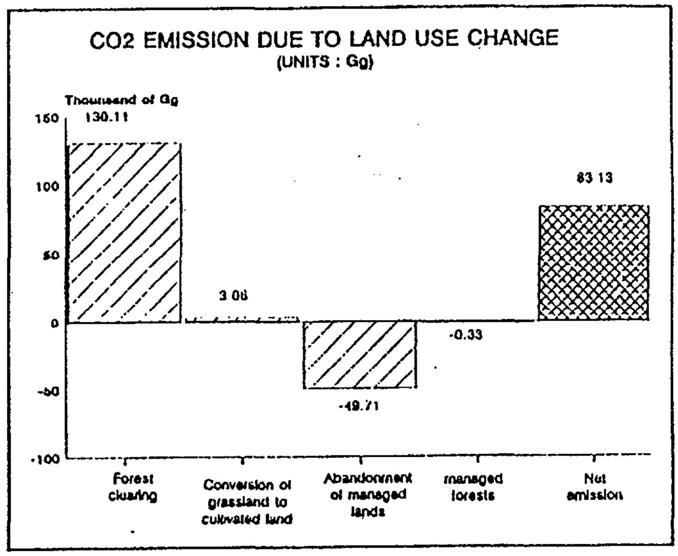

Fig. ES-7 CO_2 emission and capture from the area of land use use change and forestry.

Another sources of CO_2 emission, but in minor scale, are the industrial processes which emit 1089.22 Gg due to cement fabrication which represent only 1.3% of the total CO_2 emission in the non energy sector.

Methane is the second important gas that contributes with GHGs emissions in the non energy sector. In Peru this gas is emitted by the following sources: Agriculture and cattle, Land use change and Residues.

Methane emissions in this sector were estimated to be 1,251.96 for 1990. The major antropogenic sources are the agriculture and cattle activities which represent 54.4% of the national emissions, followed by the activities of land use change with 35.2% and finally residues accounting 10.45 of the total national methane emissions (figure ES-8).

Agriculture and cattle activities are the most important sources of methane emission. They emit 680.92 Gg due to enteric fermentation, animal manure, rice cultivation, savannas and agricultural wastes burning.

It is important to consider that, in the last two activities, CO_2 emissions have not been considered as total emission, since savannas and agricultural wastes burning are considered as sustancial elements of biomass. As a result of that the burned biomass is gradually replaced in the next year.

N_2O emissions are also emitted in the Agriculture and Catttle area; they are the result of nitrogenous fertilizers, agricultural and savanna burning.

N_2O and CH_4 result from the incomplete combustion generated in the burning.

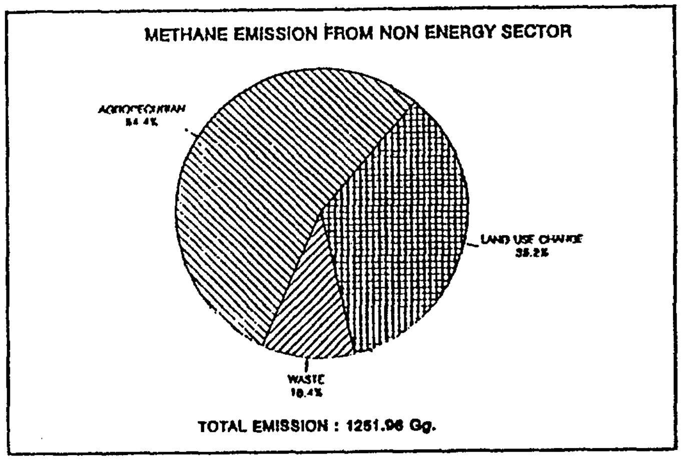

Fig. ES-8 Total methane emission from the non energy sector.

Finally the area refered to as Residues also emits methane to the atmosphere through landfills, open dumping, Industrial and domestic efluents which account 130.26 Gg of CH_4.

In this area the major and most important source of emission are the open landfills accounting 70.12 Gg of CH_4. This is due to the fact that in Peru is common the use of open landfills for the disposal of solid domestic wastes, accounting these 53.8% of the emissions in this area.

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NATIONAL GREENHOUSE GAS INVENTORY DETAILS

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INTRODUCTION

The National Inventory was carried out according to the project "Peruvian Project about Climate Change" (PCS), cooperative agreement between USA and Perú Nr DE-FCO2-94PO10129, by the National Universitiy of Engenering (UNI) (School of Enviromental Engineering FIA), the Peruvian Institution of Nuclear Energy and the National Service of Meteorology and Hidrology (SENAHMI). This project has been achieved by profesionals and students from the foregoing institutions as well by as other National Universities of the country. It also has to be considered the colaboration of The Ministry of Energy and Mines, the Ministry of Transportation, Comunication and Housing, and the Ministry of Industry, Turism and Commerce.

To achieve the organizational and sistematic purposes, groups of work were formed with the participation of profesionals from the national staff and researchers from the institutions in charge of the project and under the supervision of the UNI. The emission system was divided in two sectors: Energy Sector and Non Energy Sector. The extracction activities of fuels, the conversion of primary fuels into secondary ones and the fuel end use of the Industrial, Transportation and Other Uses sectors, have been considered in the Energy Sector. The Other Uses Sector is formed by the Residential-Commercial, Agriculture and cattle/ agricultural industry, Mining, Commercial and Public Services subsectors.

The following areas have been considered as Industrial Processes, Agriculture and cattle, Land use change, Forestry and Wastes. The Agriculture and Cattle area includes animals, rice cultivation, agricultural wastes and fertilizers; land use and forestry includes clearing of trees, conversion of grassland and abandonoment of cultivated lands; the waste areas includes landfills and waste water.

The PCS project have had duration of 2 years and 4 months between November of 1993 and March of 1996. The studies carried out were: The Inventory and Mitigation of Greenhouse Gases and the Vulnerability of the Peruvian Coast.

The study was accomplished under the supervision and technical assistance of the ICF (Consultant agent of the CSMT) for the National Inventory,. The Argon National Laboratory (ANL) and the Lawrence Berkeley Laboratory (LBL) for the Mitigation studies and finally the ANL for the Vulnerability studies. Peruvian researchers travelled to USA and so did American researchers to Peru in order to improve the quality of the studies carried out in this project. The structure of the present study shows in detail the Inventory of the Energy and non energy sectors in section I and II respectively.

I ENERGY SECTOR

The worldwide situation about energy requirement is well known. Its demand is going to continue growing at the same time as the countries look for a better standard of life; this can be noted if we take into account the worlwide energy consumption, the developed countries being the major energy consumers.

As a consequence of this, the energy is a basic service for the population and requires great efforts to optimize its use, explotation and transformation, avoiding or reducing the pollution. To this aim, its is necessary that each country establishes energy policies to ensure its development and to be part of the worldwide environmental consensus which leads to an apparent and whole evaluation of the country energy system. This evaluation includes the actualization of data about energy resources reserves and its demand as well as technologies required for their transformation, exploitation, transportation and use.

The results of the Inventory of the Greenhouse Gases (GHG) for the energy sector are shown in this section, as a result of the project **"PERU CLIMATE CHANGE COUNTRY STUDY"**.

I.1 GENERAL ASPECTS

The National Inventory of Greenhouse Gases has been determined using the basic methodology proposed by the IPCC (1, 2 and 3). This Inventory includes all the emission sources due to consumption of different types of energy resources such as emissions of CO_2, methane nitrous oxide and biomass consumption, transmission and transport of gas and oil.

The institutions in charge of the execution of the Inventory in the Energy Sector were:

1. National Institute of Nuclear Energy(IPEN).
2. National University of Engineering (UNI).

I.1.1 PERUVIAN ENERGY SITUATION

Peru Energy consumption has been historically irregular with high and low consumption increases. This variation is due to the different policy changes made by the different governments and other natural factors such as the "Corriente del niño" in 1983 and 1992. The Hydrocarbon fuels have been the most used.

NON RENEWABLE RESOURCES

CRUDE OIL

Crude oil is a non renewable resource which has priority in our country, there is not big proved reserves to satisfy a great development in the future. For this reason the ruling government is promoting local and foreign companies investments for the exploitation of this resource.

Peru has two kind of crude oil: light crude oil in the coast and heavy crude oil in the Jungle; for this reason Peru exports crude oil and heavy residual and at the same time imports light products to fulfill in an adequate form the demand of derived products.

GAS

Natural gas is the hydrocarbon which Peru has in great proved reserves, however its consumption is low because of the lack of studies and agreements for its exploitation.

The gas has its location in Cuzco (Camisea) in the Southwest of Peru. From the geographic viewpoint it is far from the main consumption centers such as Lima. Recently, Peru has signed and agreement with Shell and Mobil aimed at the explotation of the Camisea gas.

COAL

Coal is a resource which has not been examined in detail. There are studies that shows that the existing kind of coal is the anthracite which has a great content of sulfur. Due to this sulfur content, its exploitation is not appropriate. Today the greatest part of coal used by Peru is imported.

RENEWABLE RESOURCES

HIDROENERGY

The hydraulic resource is one of the most important in the country. It is used specially for electricity production, accounting 75% of the total generation. There are relatively detailed studies about the great potential of this resource. However, its use is restricted because of the need of great investments for its exploitation and for the energy transmission to consumption centers which are far from the production plants. In the coast basin, the hydraulic resource is used in great percentage (80%).

It is also important to mention that this resource depends on climate conditions such as the "Corriente del Niño" (for example in 1992) which causes nearly 34% of the electric restriction to consumption because of the rain lack in the highlands.

The studies about the use of this resource , which goes to the Atlantic Ocean, shows that it is expensive. Today, the Peruvian economic situation makes difficult to carry out its exploitation

WOOD

Wood is very important in our country, because of its use accounting to 32% of the total energy consumption of the base year. The rural Population and Urban population use wood for meeting cook needs, nevertheless the urban population use wood in low rates. This fact makes evident that other fuels are not available or are so expensive to obtain by this population.

According to the results of this study, it is proposed that the government has to implement an effective energy policy for the Rural Sector and part of the Urban Population.

DUNG

Dung as wood is used by the Rural Population to meet cooking needs.

BAGASSE

Bagasse is used, as a non energy product, for the paper production as well as for other products and in minor scale for electric energy generation.

SOLAR ENERGY

Solar energy is used mainly in departments of the highlands such as Cajamarca, Arequipa, Cuzco, Huancayo and others to dry food, heat water and in minor scale to produce energy. There are no projects about mass use or great scale electricity production.

There are, in different universities, a lot of small applications and research projects about solar energy use.

EOLIC ENERGY

Eolic energy is used to generate electricity. In some places of the coast, it is used to produce mechanical energy. There are no important projects about the eolic energy use.

GEOTHERMAL ENERGY

In Peru the geothermal energy has been the matter of preliminary studies. As it is known, there is a small potential of this resource in the southern part of the country, however there has not been any study about its quantification.

I.1.2 ENERGY BALANCE 1990

The Energy Balance of 1990 is based on the National Energy Balance and has been elaborated by the National Energy Council (CONERG) (4) of the Ministry of Energy and Mines (MEM).

The sales made to the local market reported by PETROPERU (5) as well as the data provided by ministries, national companies, private industries and service companies made it possible to verify and up date the data of the Energy Balance of 1990.

GENERAL STRUCTURE

The up dated Energy Balance of 1990 has the same structure as the National Balance made by CONERG. The following definitions has been used in the general structure of the Energy Balance:

- **Primary Energy,** are the different energy products in its natural form. For the case of the Peruvian balance , these products are: hydroenergy, associated and non associated natural gas, crude oil, dung, bagasse, wood and coal.

- **Transformation**, is the process by which the primary energy resources are transformed into secondary energy resources. Among the main transformation process we have: thermal powerplants, coker plants, charcoal plants, refineries and gas plants.

- **Secondary energy products**, are the different energy products which are appropriate for the different forms of consumption. Its origin is always a transformation center and its destination a consumption center. For the case of the Peruvian Energy Balance, we have the following secondary products: coke, charcoal, liquified petroleum gas, motor gasoline, jet fuel, diesel oil, residual oil, gas, gas from refineries, distributed gas, industrial gas and electrical power.

- **Consumption**, is the process by which the secondary energy products are used according to specific ways of use. It is one of the great function of the Energy Balance.

For the Peruvian case we have the following consumption sectors: Commercial-Residential, Agriculture and cattle/Agricultural industry, Transportation, Industry, Mining-Metallurgy and Fishing.

The Energy Balance 1990 for this study is shown in table I.1.1; it has a vertical division that separates the Primary Energy Sector, the Secondary Energy Sector, the Total Primary Energy (TOTAL EP, column 8), the Total Secondary Energy (TOTAL SE, column 21), the Total Energy (TOTAL, column 22) and the fuel names. In the horizontal division we have the Production Identification (row 1), Importation (row 2) and Inventories Variation (row 3). In the following rows we have, the Total Offer (row 4), Export (row 5), Non used Energy (row 6), Gross Internal Offer (row 7), Total Transformation (row 8), Own Energy Consumption (row 9), Transportation Loss, Distribution and Storage (row 10), Adjustments (row 11), Total and Final Consumption (row 12) which contains non Energy final consumption (row 12.1) and finally the Energy Consumption (12.2). The Final Energy Consumption is divided in the following sectors: Commercial. Residential (row 12.2.1), Public (row 12.2.2), Transportation (row 12.2.3), Agriculture and cattle/Agricultural industry (row 12.2.4), Fishing (row 12.2.5), Mining and Metallurgy (12.2.6), Industrial (row 12.2.7) and Non identified Consumption (row 12.2.8).

The data referred as adjustments had statistical tools which are been used to balance the supply and consumption data from the different information sources.
In table I.1.1, the quantities in parenthesis has been used as primary resources for the production of secondary resources such as: oil, coal , wood, bagasse, natural gas, hydroenergy and coke.

UNIT : THOUSAND OF TOE (kTOE)

ACTUALIZED ENERGY BALANCE

YEAR : 1,990

	REPUBLIC OF PERU / PERU CLIMATE CHANGE COUNTRY STUDY / PCS-IPEN	PRIMARY ENERGY 1 COAL	2 WOOD	3 DUNG	4 BAGAS	5 CRUDE OIL	6 ASSOC. NAT. GA	7 HYDRO ENERGY	8 TOTAL P. E.
	1. PRODUCTION	66.26	3,515.82	259.49	316.60	6,492.86	757.34	1,125.86	12,536.24
	2. IMPORT	29.86	0.00	0.00	0.00	887.38	0.00	0.00	917.74
	3. STOCK CHANGE	8.49	0.00	0.00	0.00	(82.36)	0.00	0.00	(75.87)
E F									
N F	4. TOTAL OFFER	104.61	3,515.82	259.49	316.60	7,298.38	757.34	1,125.86	13,378.11
E E									
R R	5. EXPORT	0.00	0.00	0.00	0.00	(149.52)	0.00	0.00	(149.52)
G	6. NOT USED	0.00	0.00	0.00	0.00	0.00	(185.08)	0.00	(185.08)
Y									
	7. GROSS INTERNAL OFFER	104.61	3,515.82	259.49	316.60	7,148.86	572.27	1,125.86	13,043.52
S									
E C	8. TOTAL TRANSFORMATION	(26.04)	(309.69)	0.00	(45.50)	(7,431.71)	(512.63)	(1,125.88)	(9,451.65)
C	8.1 COKE PLANT/BLAST FURN	(26.04)	0.00	0.00	0.00	0.00	0.00	0.00	(26.04)
T T	8.2 CHARCOAL PLANTS	0.00	(309.69)	0.00	0.00	0.00	0.00	0.00	(309.69)
O R	8.3 REFINERIES	0.00	0.00	0.00	0.00	(7,431.71)	0.00	0.00	(7,431.71)
R A	8.4 GAS PLANTS	0.00	0.00	0.00	0.00	0.00	(512.83)	0.00	(512.83)
N	8.5 P.S. ELECTRIC POWER PLA	0.00	0.00	0.00	0.00	0.00	0.00	(942.73)	(942.73)
S	8.6 S.P. ELECTRIC POWER PLA	0.00	0.00	0.00	(45.50)	0.00	0.00	(183.15)	(228.65)
	9. SELF CONSUMPTION	0.00	0.00	0.00	0.00	(0.00)	0.00	0.00	(0.00)
	10.LOSSES(TRANS.DIST. STOR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	11. AJUSTEMENTS	(14.79)	0.00	0.00	0.06	282.85	(59.44)	0.00	208.68
F	12. TOTAL FINAL CONSUMPTI	83.78	3,206.13	259.49	271.15	0.00	0.00	0.00	3,800.55
I									
N	12.1 NON ENENRGY FINAL CONSUMPTION				148.32				
A	12.2 ENERGY FINAL CONSUMP	83.78	3,206.13	259.49	122.84	0.00	0.00	0.00	3,652.23
L	12.2.1 RESIDENTIAL/COMMER	7.43	2,761.51	259.49	0.00	0.00	0.00	0.00	3,028.43
	12.2.2 PUBLIC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C	12.2.3 TRANSPORT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
O	12.2.4 AGRIC. CATTLE/AGRIC. I	0.00	0.00	0.00	122.84	0.00	0.00	0.00	122.84
N	12.2.5 FISHING	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S	12.2.6 MINING METALLURGICA	7.85	0.00	0.00	0.00	0.00	0.00	0.00	7.85
U	12.2.7 INDUSTRY	48.50	444.61	0.00	0.00	0.00	0.00	0.00	493.12
M	12.2.8 NON IDENTIFIED CONSU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

PCS-IPEN	SECONDARY ENERGY 9 COKE	10 CHARC	11 LPG	12 MOTOR GASOLIN	13 JET KEROSEN	14 DIESEL OIL	15 RESID. OIL	16 NON EN OIL/GAS	17 REFIN. GAS	18 DIS. GAS	19 IND. GAS	20 ELECTR. POWER	21 TOTAL S. E.	22 TOTAL
1. PRODUCTION	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12,536.24
2. IMPORT	41.27	0.00	63.21	36.49	70.63	520.11	0.00	16.96	0.00	0.00	0.00	0.00	750.70	1,668.44
3. STOCK CHANGE	0.00	0.00	2.91	(0.96)	7.57	(5.72)	16.92	(1.77)	(0.74)	0.00	0.00	0.00	18.19	(57.68)
4. TOTAL OFFER	41.27	0.00	66.11	35.51	78.21	514.39	16.92	17.21	(0.74)	0.00	0.00	0.00	768.66	14,147.00
5. EXPORT	0.00	0.00	0.00	(72.61)	0.00	(11.21)	(2,030.56)	0.00	0.00	0.00	0.00	0.00	(2,114.60)	(2,264.12)
6. NOT USED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(185.08)
7. GROSS INTERNAL OFFER	41.27	0.00	66.11	(37.30)	78.21	503.19	(2,013.67)	17.21	(0.74)	0.00	0.00	0.00	(1,345.72)	11,697.80
8. TOTAL TRANSFORMATION	(11.36)	123.88	149.18	1,305.62	1,028.51	763.91	3,299.40	67.63	68.63	377.52	20.61	1,187.41	8,380.95	(1,070.70)
8.1 COKE PLANT/BLAST FURN	(11.36)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.61	0.00	9.25	(16.79)
8.2 CHARCOAL PLANTS	0.00	123.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	123.88	(185.81)
8.3 REFINERIES	0.00	0.00	139.77	1,276.10	1,028.51	1,183.81	3,639.50	44.35	68.63	0.00	0.00	0.00	7,382.67	(49.04)
8.4 GAS PLANTS	0.00	0.00	9.41	27.52	0.00	0.00	0.00	23.28	0.00	452.82	0.00	0.00	512.83	0.00
8.5 P.S. ELECTRIC POWER PLA	0.00	0.00	0.00	0.00	0.00	(186.30)	(72.90)	0.00	0.00	0.00	0.00	821.10	561.90	(380.83)
8.6 S.P. ELECTRIC POWER PLA	0.00	0.00	0.00	0.00	0.00	(233.60)	(267.20)	0.00	0.00	(75.09)	0.00	366.31	(209.58)	(438.23)
9. SELF CONSUMPTION	0.00	0.00	0.00	(3.50)	(2.50)	(77.10)	(80.10)	0.00	(68.63)	(347.36)	(6.95)	(12.03)	(598.29)	(598.29)
10.LOSSES(TRANS.DIST. STOR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(161.27)	(161.27)	(161.27)
11. AJUSTEMENTS	(3.07)	0.02	(26.50)	(25.01)	(131.73)	172.30	(17.88)	(4.47)	0.74	44.15	(4.28)	0.00	4.20	212.90
12. TOTAL FINAL CONSUMPTI	26.84	123.90	166.80	1,239.80	972.38	1,362.30	1,187.75	80.38	0.00	74.30	9.40	1,014.20	8,279.98	10,080.52
12.1 NON ENENRGY FINAL CONSUMPTION					1.04			60.73					61.70	210.00
12.2 ENERGY FINAL CONSUMP	26.84	123.90	166.80	1,239.80	971.34	1,362.30	1,187.75	19.65	0.00	74.30	9.40	1,014.20	8,218.28	9,870.52
12.2.1 RESIDENTIAL/COMMER	0.00	123.90	166.70	0.00	683.24	0.00	0.00	0.00	0.00	45.90	0.00	387.00	1,406.74	4,435.17
12.2.2 PUBLIC	0.00	0.00	0.00	73.60	60.74	125.70	22.63	1.55	0.00	0.00	0.00	0.00	284.43	284.43
12.2.3 TRANSPORT	0.00	0.00	0.00	1,148.40	221.16	1,035.20	100.40	11.23	0.00	0.00	0.00	0.00	2,516.39	2,516.39
12.2.4 AGRIC. CATTLE/AGRIC. I	0.00	0.00	0.00	2.80	0.20	18.60	67.91	0.07	0.00	0.00	0.00	20.40	109.78	232.62
12.2.5 FISHING	0.00	0.00	0.00	0.30	0.00	39.90	165.82	0.07	0.00	0.00	0.00	10.00	216.09	216.09
12.2.6 MINING METALLURGICA	26.84	0.00	2.10	11.35	4.80	50.50	271.79	4.62	0.00	0.00	0.00	279.70	651.50	659.35
12.2.7 INDUSTRY	0.00	0.00	0.00	3.35	1.40	92.40	559.20	2.10	0.00	28.40	9.40	337.10	1,033.35	1,526.47
12.2.8 NON IDENTIFIED CONSU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GROSS SECONDARY ENENRGY PRODUCTION	23.02	123.86	149.18	1,305.57	1,028.51	1,183.81	3,645.19	215.95	68.83	452.62	20.61	1,188.26	9,405.23	

PRODUCTION OF COKE = 23.02 + BLAST FURNACE ENT (34.40) = (11.38)

Carry out by : PCS Energy Sector
Sources: MEM and PETROPERU S.A.

Table I.1.1 Peru's National Energy Balance

I.2 EMISSIONS FROM THE ENERGY SECTOR

I.2.1 EXTRACTION

The extraction, production and distribution of primary coal and hydrocarbon resources used as energy resources have been considered in this activity. Methane emissions have only been considered in this activity. CO_2 emissions due to fuel consumption in the extraction, production and distribution activities have been quantified in the mining and transportation subsector.

I.2.1.1 OIL, GAS AND COAL EXTRACTION

I.2.1.1.1 hydrocarbons

In this section, we present data about the production of energy resources such as: crude oil, natural gas and proved reserves.

I.2.1.1.1.1 Crude oil

Crude oil production in 1990 was 47049,690 barrels with a daily rate of 128,900 barrels. This production was taken from the three companies in charge of its production, PETROPERU, OCCIDENTAL and OXI BRIDAS. Table 1.2.1 shows the production and proved reserves of each company for 1990 [6].

ENTERPRISES	PRODUCTION (Thousands of barrels)	%	PROVED RESERVES (Thousand of barrels)	%
PETROPERU				
. NOROESTE	6882.66	14.63	104733	27.40
. SELVA NORTE	7625.68	16.21	54741	14.32
. SELVA CENTRAL	718.56	1.53	2698	0.71
SUBTOTAL PETROPERU	15226.9	32.37	162172	42.43
PETROMAR	7783.16	16.54	95877	25.03
OCCIDENTAL	21856.74	46.45	108767	28.48
OXY-BRIDAS	2182.90	4.64	15565	4.07
TOTAL	47049.69	100	382181	100

Table I.2.1 Crude oil proved reserves and production for 1990.

I.2.1.1.1.2 Natural Gas

Natural gas production for 1990 was 32364,960 cubic feets. The companies in charge of its exploitation were PETROPERU, OCCIDENTAL, OXY BRIDAS) (6). Table 1.2.2 shows the natural gas production of each company for 1990. Gas reserves for 1990 were

7.075 trillions cubic feet (7.075 * 10^{12} cubic feet) being Camisea gas reserves (Cuzco) the most important. Table 1.2.3 shows proved gas reserves.

ENTERPRISES	PRODUCTION (Thousand of feet cubics)	%
PETROPERU		
. NOROESTE	7217386	22.3
. SELVA ASOCIADOS	517839	1.6
. NO ASOCIADOS	1132774	3.5
SUBTOTAL PETROPERU	8867999	27.4
PETROMAR	21231414	65.6
OCCIDENTAL	1359328	4.2
OXY-BRIDAS	906219	2.8
TOTAL	32364.96	100

Table I.2.2 Natural gas production of 1990 [7].

ENTERPRISES	RESERVES (Tera feet cubics)	%
NOT ASIGANED	6.47	91.45
PETROPERU	0.37	5.17
PETROMAR	0.22	3.10
OCCIDENTAL	0.014	0.20
OXY-BRIDAS	0.006	0.08
TOTAL	7.075	100

Table I.2.3 Gas Reserves for 1990.

I.2.1.1.1.3 Coal

In 1990, the total coal production was 100,200 Tonnes , accounting anthracita 82,400 and bituminoso coal 17,800. 47,000 Tonnes were imported in order to meet a national demand of 147,200.

I.2.1.2 METHANE EMISSION DUE TO EXTRACTION ACTIVITIES

Methane emission (CH_4) from post mining coal processes and extraction, fugitive emission due to production, transformation and refining of oil and gas, in the transmission and distribution of it to central power plants, in industrial sector and the residential commercial subsector have been estimated.

Table I.2.4 shows the energy resource production for 1990.

TYPES OF PRODUCTS		UNIDADES a,b,c	kTEP
CRUDE OIL		47049.69[a]	6492.86
NATURAL GAS		32364.96[b]	757.34
COAL	ANTRACITE	82.40[c]	57.68
	BITUMINUOS	17.80[c]	10.58
SUBTOTAL		100.20	68.26
BIOMASS	WOOD	9766.17[c]	3515.82
	BAGASSE	2109.44[c]	316.60
	DUNG	741.40[c]	259.49
SUBTOTAL		12617.01	4091.91
TOTAL			11410.37

[a] Thousand of barrels (kbbls)
[b] Millions of feet cubics (kfc)
[c] Thousand of Tonnes (kTons).

Table I.2.4 Energy Resources production of 1990 [7].

IPCC methology (Greenhouse Gas Inventory-workbook) was used to determine methane emissions from extraction activities. (pag. I.9-I, 45) [2].

Since we do not have national values, emission factors were taken from the workbook. The "IPCC Guidelines for National Greenhouse Gas Inventory Vol.II" presents two types of values; the first corresponds to the low emission rate and the second one to the high rate. In the present study, the high emission rate has been considered in all cases except the emission rate due to gas leakage from industrial plants, because this methodology of the IPCC only presents low emission rates for this case.

CATEGORY		Gg de CH_4
COAL PRODUCTION		
UNDERGROUND MINING	Mining	1.68
	Post-Mining	0.27
SUBTOTAL		1.95
CRUDE OIL PRODUCTION		
PRODUCCION		1.36
OIL TRANSPORTATION		0.23
REFINING		0.23
STORAGE		0.08
SUBTOTAL		1.90
GAS USE AND PRODUCTION		
PRODUCTION		3.04
PROCESSING		6.18
TRANSMISION AND DISTRIBUTION[a]		2.45
ELECTRIC PLANTS		0.55
INDUSTRIAL PLANTS		0.21
RESIDENTIAL COMMERCIAL		0.08
VENTING AND FLARING IN GAS PRODUCTION		6.09
SUBTOTAL		18.61
TOTAL EMISION		22.46

[a] In this case, to calculated we had considered the total gas consumption.

Table I.2.5 Methane emissions due to energy products extraction

Appendix D shows in detail the estimates for methane and nitrous oxide emissions. Table 1.2.4 presents the total production of crude oil, coal and biomass in original units and tonnes of oil equivalent (TOE) for 1990.

Table I.2.5 shows Methane (CH_4) emissions due to coal extraction, gas and oil transportation and distribution as well as the losses in the production of gas.

I.2.2 CONVERSION

The activity referred to as "Conversion"includes the transformation centers of primary energy products into secondary ones as well as electricity power plants and transformation systems of secondary energy products into other products. Figure I.2.2.1 presents a diagram of the conversion activity elaborated in order to accomplish this study.

The main conversion system of the country are:

- Refineries
- Electricity Power plants (Public and Autoproducing)
- Gas plants
- Charcoal plants
- Coke plants and Furnaces

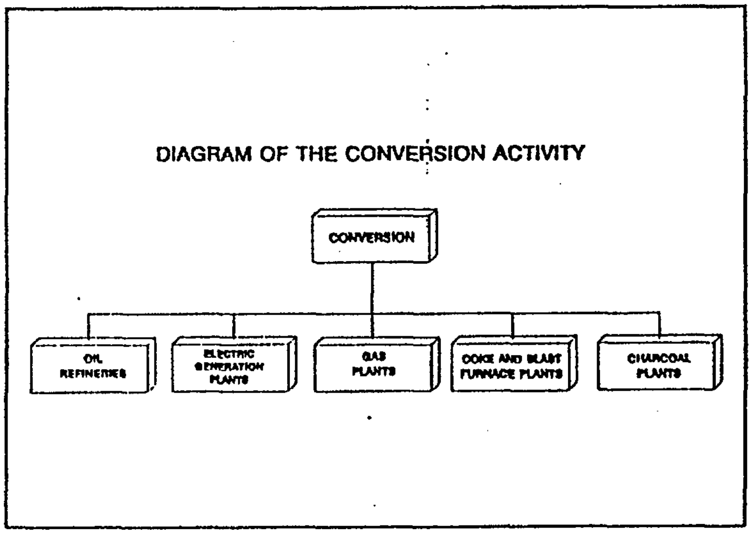

Fig. I.2.2.1 Diagram of the activities carried out in the conversion activity [10].

The energy products obtained from the different conversion centers are: coke, charcoal, liquified gas, gasoline, kerosene, jet fuel, diesel oil, residual oil, non energy products, distributed gas, refinery gas, industrial gas, electric energy.

I.2.2.1 SECONDARY ENERGY PRODUCTS OFFER FOR 1990

For 1990, secondary energy production in Tonnes of oil equivalent kTOE was 8,381. As it can be observed from figure I.2.2.2, 84.2% of the production are hydrocarbons from refineries and gas plants, 14.2% from hydroelectric and thermoelectric units (natural gas, diesel oil and residual), 1.6% from other products (charcoal derived from incomplete wood combustion, industrial gas otained from coal and coke from coke plants and furnaces).

The loss of primary energy products due to efficiency of the transformation centers was 1,071 kTOE from which 17 kTOE was in coke plants and furnaces, 186 kTOE in charcoal plants, 49 kTOE in oil refineries, 381 kTOE in public electric generation plants and 438 kTOE in electricity autoproducing plants.

In 1990, 751 kTOE of secondary energy products were imported: 520 kTOE of diesel oil (69.3%), 41 kTOE of coke (5.5%), 63% kTOE of GLP (8.4%)., 37 kTOE of motor gasoline (4.9%), 71 kTOE of kerosene and jet fuel (4.9%) and 19 kTOE of non energy products (2.5%) of oil and gas.

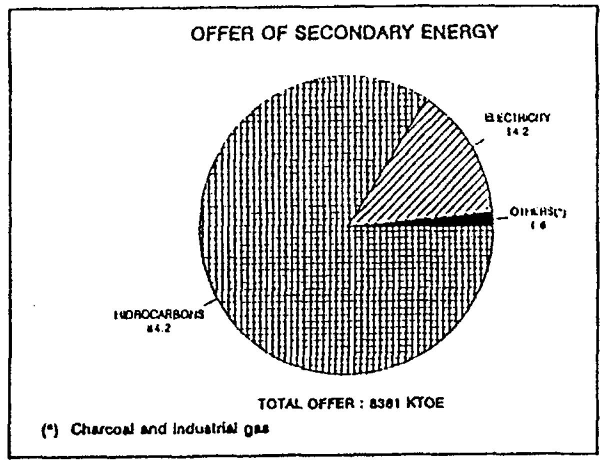

Figure I.2.2.2 Percentage composition of the secondary energy production in 1990.

The total secondary products exportation was 2,115 kTOE; 2031 kTOE of residual oil (96%), 73 kTOE of motor gasoline (3.5%) and 11 kTOE of diesel oil (0.5%). The own consumption in the energy sector was 598 kTOE,using 232 kTOE in refineries, 347 kTOE in gas plants, 12kTOE in electricity ganeration and 7 kTOE in coke plants and furnaces [5].

The loss from energy distribution was, in respect to electric energy, 13.6% of the total energy production.

I.2.2.2 REFINERIES

The average of raw material charged to refeneries in the country during 1990 was 149,177 barrels per day. 12% of this amount was imported from Ecuador and a small percentage from Colombia (table I.2.2.1) [7].

REFINED MATERIAL	B/Dc
DOMESTIC OIL	128921
IMPORTED OIL	18622
NATURAL GAS	778
REPROCESSING	856
TOTAL	149177

Table I.2.2.1 Hidrocarbons refining in 1990.

The quantity processed by five refineries of the country during 1990 made posible the use of 87% of the available refining capacity. The Pampilla refinery registered the greatest production accounting 53.9% of the total. Table I.2.2.2 shows the quantities of refining by each refinery in 1990. The refining products obtained during 1990 reached a total of 149,177 of barrels per day. Crude oil quality (very heavy) from the peruvian jungle (Loreto), which supplied the refineries, was the main reason of the loss of equilibrium in the oil refining process was because of the crude oil quality. As a consequence of this, a deficit in the energy balance was generate. Table I.2.2.3 presents in detail the refining products obtained.

VOLUME	B/Dc
LA PAMPILLA	80447
TALARA	56981
IQUITOS	6384
CONCHAN	3725
PUCALLPA	1640
TOTAL	149177

Table I.2.2.2 Volume of crude oil processing in 1990.

REFINED PRODUCTS	B/Dc
LPG	4,033
Gasoline	26,989
Jet Fuel	5,572
Kerosene	15,615
Diesel	23,502
Residual	67,841
Non Energy	5,206
Looses (Eficiency)	419
TOTAL	149,177

Table I.2.2.3 Refining products obtained in 1990.

Figure I.2.2.3 shows the historical development of the oil refining in between 1986 and 1992.

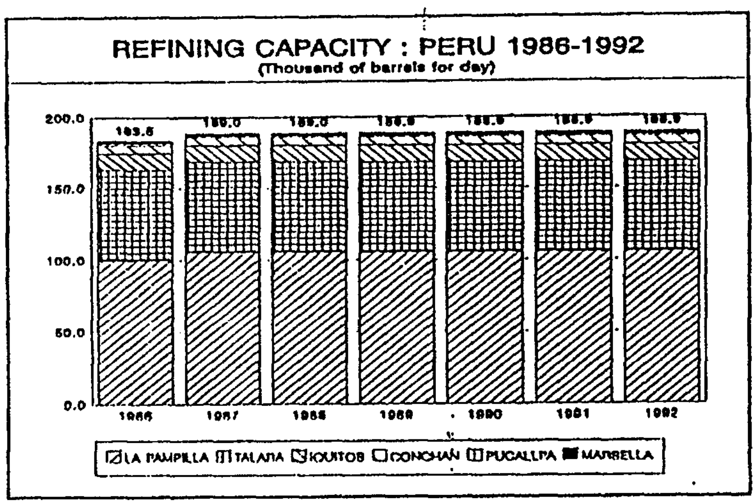

Fig. I.2.2.3 Historical evolution of oil refining in Peru between 1986-1992 [8].

I.2.2.3 ELECTRICAL POWER PLANTS

The results obtained from the electricity generation during 1990 mainly includes:

- Electricity Energy Balance
- Fuel Consumption by Thermal power Plants

The data was supplied by the officers of the Peruvian goverment (Ministry of Energy and Mining, National Company of Electricity ELECTROPERU S.A)[6, 7,8].

I.2.2.4 ELECTRICITY GENERATION

The total electricity generation of 1990 was 13,807 Gwh, from which 76% (10,483.4 Gwh) corresponds to the hydraulic production and 24% (3,323.9 Gwh) to thermal production. The electricity generation from public companies was 8779.7 Gwh (92%) from hydraulic origin and 768.1 Gwh (8%) from thermal origin accounting a total of 9547.8 Gwh.

The electricity generation from private companies (autoproducers) was 4,259.5 Gwh, from which 1,703.7 Gwh corresponds to the hydraulic production (40%) and thermal production was 2,555.7 (60%).

Figure I.2.2.4 shows a graphical comparison of the electricity production by each kind of service. Table I.2.2.4 shows the electricity production according to the generation and type of service during the period between 1970-1992.

ELCTRICITY PRODUCTION BETWEEN 1970-1990
(GWH)

YEAR	PUBLIC SERVICE		SELF-PRODUCERS		SUBTOTAL		TOTAL
	HIDRO	THERMAL	HIDRO	THERMAL	HIDRO	THERMAL	
1970					3820.6	1708.2	5528.8
1971	3092.8	204.0	1190.0	1462.1	4282.8	1666.1	5948.9
1972	3231.1	294.1	1207.7	1556.4	4438.8	1850.5	6289.3
1973	3567.1	324.7	1201.5	1161.6	4768.6	1486.3	6254.9
1974	3980.3	335.2	1240.0	1719.6	5220.3	2054.8	7275.1
1975	4281.2	384.5	1188.8	1631.7	5470.0	2016.2	7486.2
1976	4623.4	408.5	1174.3	1704.9	5797.7	2113.4	7911.1
1977	4868.0	481.6	1159.0	2118.4	6027.0	2600.0	8627.0
1978	5004.6	485.2	1193.8	2081.2	6198.4	2566.4	8764.8
1979	5383.0	577.9	1315.3	1989.1	6698.3	2567.0	9265.3
1980	5748.3	640.2	1264.1	2386.1	7012.4	3026.3	10038.7
1981	6677.5	609.8	1319.3	2150.3	7996.8	2760.1	10756.9
1982	6980.5	657.3	1420.3	2292.3	8400.8	2949.6	11350.4
1983	6752.6	706.2	1357.9	1858.2	8110.5	2564.4	10674.9
1984	7240.9	834.0	1330.0	2312.1	8570.9	3146.1	11717.0
1985	7583.3	796.2	1802.2	1933.6	9385.5	2729.8	12115.3
1986	8443.0	791.4	1437.5	2269.4	9880.5	3060.8	12941.3
1987	9196.3	896.4	1450.0	2242.1	10646.3	3138.5	13784.8
1988	9077.9	944.9	1348.2	2173.0	10426.1	3117.9	13544.0
1989	8848.1	748.6	1546.2	2215.6	10394.3	2964.1	13358.4
1990	8779.7	768.2	1703.7	2555.7	10483.4	3323.9	13807.3

Table I.2.2.4 Historical electricity generation between 1970-1990 [8].

I.2.2.5 GAS PLANTS

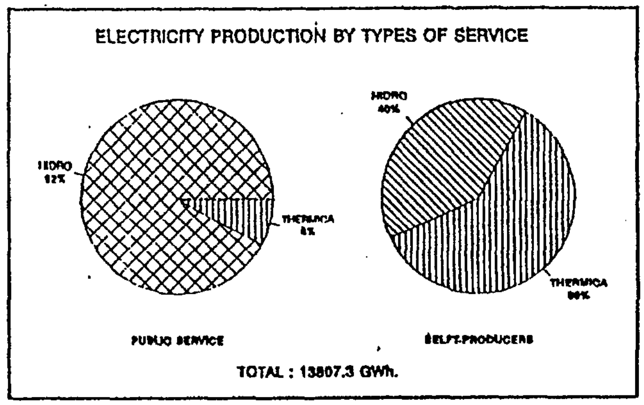

Fig. I.2.2.4 Graphical comparison of the electricity production from public and private companies in 1990 [8].

In the 1960s, natural gas showed an important development in our country due to the industrial expansion of PETROPERU. The most important uses of natural gas according to their importance are:

- Gas used as fuel for refineries
- Gas used as fuel for thermal electricity plants
- Gas used as fuel for oilproduction
- Gas used as fuel by the industrial and commercial areas.
- Gas used as fuel by the population
- Gas for injection into reservoirs

The total natural gas production during 1990 presents a volume of 104292,00 cubic feet per day [7].

There are two types of natural gas: ASSOCIATED GAS, which is produced along with oil and is separated in production bateries in the surface through gravity based separation methods, then it is picked up and transported. NON ASSOCIATED GAS, which comes from gas reservoirs and is used after it has been processed.

Associated gas production accounts for 97% of the total production.

I.2.2.6 NATURAL GAS PROCESS

Gas plants processes this resource by using the absorption method. This method consists of mixing a solvent, kerosene, with gas; the solvent absorbs the liquids hydrocarbons (propane, butane, pentane and heavy oil). After this, gas is referred to as dry Gas formed basically by methane and ethane.

This pocess is completed when the liquid hydrocarbon is separated and kerosene returns to the absorption plant. Liquid hydrocarbons are finally destilled until they are separated into GLP (propane and butane) and natural gasoline (penthane and heavier) which is then pumped to the refineries and used as commercial gasoline component with gasoline cuts produced in refineries.

Hexane is obtained in order to be sold as a solvent.

Table I.2.2.5 shows the products obtained from natural gas plants during 1990.

PRODUCTS	UNITS	CONVERSION FACTORS	KTOE
LPG	99.1 kBbl	0.095	9.4
GASOLINE	225.6 kBbl	0.122	27.5
DRY GAS	19342.6 10^6 cf	0.0234	452.6
NON ENERGY PRODUCTS . Fertilizers . Hexan . Pantane	168.7 kBbl 844.6 10^6 cf 25.5 kBbl --	0.138 2.34 10^{-5} 0.138 0.138	23.2 19.7 3.5 --

Table I.2.2.5 Products obtained from gas processing.

I.2.2.7 WOOD AND CHARCOAL PLANTS

Biomass is an important energy resource for Peru, for this reason we made a detailed estimation of wood and charcoal consumption in this section.

Wood Consumption

1. Considering 1992 as the base year, the specific consumption has been estimated for the Residential Sector and industrial activities taking into account the following details:

   Residential = 1.0748885 TM/ hab-year
   Bakeries = 0.03111 TM/ hab-year
   Brick factories = 0.08639 TM/ hab-year
   Others = 0.05556 TM/ hab-year

   (*) Hab -year: It refers to the habitant who consumes wood during a year.
   The growth rate of the population who consumes wood is 1.365%.

2. The consumer population was 6403 $\times 10^3$ hab. In 1982 and 7137 x 10^3 hab. in 1990.

3. The wood consumption from the Industrial Sector was determined according to the specific consumption and the consumer population.

a) Residential Consumption:
7137 x 10^3 hab. X10748885 MT/ hab- year = 7671 x 10^3 MT
In TOE unities is: 7671x 10^3 MT x 360 TOE/ 103 MT = 2762x 10^3 TOE.

b) Industrial Consumption
Consumption in Bakeries:
7137 x 10^3 hab. X 0.03111 MT/hab-year = 22 x 10^3 MT
Consumption in brick factories:
7137 x 10^3 hab. X 0.08639 MT/ hab-year = 617 x 10^3 MT
Consumption in other industrial activities:
7137 x 10^3 hab x 0.05556 MT/ hab-year = 397 x 10^3 MT
Sub total = 1236 x 10^3 MT x 360 TOE/ 10^3 MT = 445 x 10^3 TOE

c) The amount of wood that enter into the charcoal plants is 880 x 10^3 MT
In TOE unities is 860 x 10^3 MT x 360 TOE/10^3 MT = 310 x 10^3 TOE.

d) Making a summary of (a) + (b) + (c) we obtain a total of: 9766 x 103 MT.
In TOE unities is: 9766 x 10^3 MT x 360 TOE/10^3 MT = 3516 x 10^3 TOE.

The conversion factors were supplied by the Ministry of Energy and Mining (Natioanl Energy Balance) [9].

Charcoal Consumption

1. For the charcoal consumption in houses, we have considered the following data:

- The specific consumption is 0.849 TM/hab
- The number of charcoal consumers is reducing each year (growth rate : 97.37%).
- In 1982, the consumer population was 19.5 x 10^3 habitants and in 1990 15.7 x 10^3 hab.

2. For the Charcoal consumption in poultry market (commercial consumption), we have considered the following figures:

- The consumption growth rate is 1.3%
- In 1982 the consumption was 161x 10^3 MT and in 1990 it was 177.3 x 10^3 MT.

3. According to the foregoing data, the total charcoal consumption was:

a) Charcoal consumption in houses:
15.7 x 10^3 hab.x 0849 TM/hab = 13.3 x 10^3 TM .
b) Charcoal consumption in poultry market (commercial):
177.3 x 10^3 MT.
Total charcoal consumption (a) + (b) = 190.6 x 10^3 MT.

The total wood and charcoal consumption is shown in table I.2.2.6.

I.2.2.8 COKE PLANTS AND FURNACES

COAL PRODUCTION

PRODUCTION/CONSUMPTION	KMT	KTO
WOOD		
- Production	9766	3516
- Consumption in the Transformation	860	310
CHARCOAL		
- Total Transformed	191	124

Table I.2.2.6 Wood and charcoal consumption and production.

The National coal production of 1990 was 100,200 Tonnes, although there was a non covered demand of 37,500 Tonnes/year which was covered by importation.

From a net ineternal offer of 147,200 Tonnes/year, only 68.1% was covered by national production, 25% was supplied with imported coal and the remaining 64% with the existing stock from the different companies.

The stablishment of a consistent and reliable local market for coal as well as a political policy that promotes the national production of this important fuel, would help to cover the local demand, developing in this manner an important industrial activity in the country at short term.

The main coal consumers during 1990 were cement factories which constituted an important market. Since there were no producers of coal who could cover the coal demand and as the national production of coal is not appropiate, the cement factories were suplied with imported coal.

Together with cement factories, the companies that demand this product were national companies as CENTROMIN PERU for its blast furnace in la Oroya, and SIDER PERU for its steel plants in Chimbote.

The coke plant of CENTROMIN PERU was first supplied with coal from the Goyllarisquizga mine, this coal was mixed with coal imported from Bradford, USA. SIDER PERU imported coke in order to mantain its furnaces in operation.

There were also small industries which were part of a small market of fossil coal from Peru, these industries were brick factories, briquets factories and blast furnaces.

Coal consumption by the economical sectors of the country

In peru, the local market of charcoal is divided in two groups:

1. National Companies: Centromin Peru and Sider Peru.

These companies requires butiminous coal and coke. These coals are imported by both companies.

2. Private Companies:

	Antracite (kton)	Goyllar (kton)	Prodeco (kton)	TOTAL kTon	TOTAL kTOE
- Production	82.4	17.8	-	100.2	68.3
- Imported	-	-	37.5	37.5	29.9
- Change of Stock	8.0	1.5	-	9.5	6.5
- Consumption in the transformation	-	43.9	-	43.9	26.0
- Total consume	90.7	-	0.3	91.0	63.8

Table I.2.2.7 Coal production and consumption [9].

Cement Industries, Brick factories, Blast furnaces, compressed gas factories. These Companies form the national market of coal.

The Natioanl Energy Balance estimates the coal consumption in the following sectors:

a. Mining-Metallurgy sector which has CENTROMIN PERU as the major consumer. This company requires an amount of 11,000 Tonnes/ year.

b. Industrial Sector , the main coal consumers are the cement and brick industries which have a local demand of 69,300 Tonnes/ year. This demand was parcially covered using the charcoal produced by some local industries.

c. Residential Sector shows a greater consumption accounting a total of 10,600 Tonnes/year of charcoal. The major consumer are the briquets factories and the consumption from the workers of NORPERU S.A.

The results of the production, transformation, importation and total consumption of coal are shown in tables I.2.2.7 and I.2.2.8.

Industrial gas consumption and production was 20.6 kTP. (This product comes from the Charcoal transformation).

COKE	TOTAL (Kton)	TOTAL (KTOE)
- Production	34.0	23.0
- Importation	64.5	41.3
- Entrance to blast furnace	57.2	34.4

Table I.2.2.8 Coke production, importation and consumption.

I.2.2.9 CO2 EMISSIONS INVENTORY FROM THE CONVERSION ACTIVITY

In order to accomplish the present study, CO_2 emission estimates from the conversion activity were carried out using the IPCC methodology. The Conversion activity was divided in : Electricity generation, Other Conversion Processes and Own Consumption from the energy sector.

Electricity Generation includes public thermal plants and autoproducing thermoelectric plants. Other Conversion processes includes fuel consumption and emissions from refineries, gas plants, coal plants, coke plants and furnaces.

Table I.2.2.9 shows the fuel consumption and the CO_2 emission from the electricity generation.

Table I.2.2.10 shows the fuel consumption and CO_2 from other conversion process. Table I.2.2.11 shows the fuel consumption and the CO_2 emission from the own consumption of the energy sector. The IPCC worksheet about these estimates are shown in appendix A.

ELECTRICITY GENERATION

FUEL	CONSUMPTION (KTOE)	EMISSION CO_2 (Gg)
	LIQUID	
RESIDUAL	340.10	1090.63
DIESEL	419.90	1289.10
SUBTOTAL	760.00	2379.73
	GAS	
DISTRIBUTED GAS	75.09	174.34
SUBTOTAL	75.09	174.34
	SOLIDS	
BAGASSE	45.40	183.38
SUBTOTAL	45.40	183.38
TOTAL	880.49	2737.45

Table I.2.2.9 Fuel consumption and CO_2 emissions from electricity generation.

OTHER PROCESS

FEUL	CONSUMPTION (KTOE)	EMISSION CO_2 (Gg)
	LIQUID	
CRUDE OIL	49.04	149.06
SUBTOTAL	49.04	149.06
	SOLIDS	
COAL	3.02	11.72
COKE	13.77	61.11
WOOD	185.81	742.02
SUBTOTAL	202.60	814.85
TOTAL	251.64	963.91

Table I.2.2.10 Fuel consumption and CO_2 emissions from other process.

OWN CONSUMPTION

FUEL	CONSUMPTION (KTOE)	EMISSION CO_2 (Gg)
	LIQUID	
GASOLINE	3.50	10.05
KEROSENE	2.60	7.74
RESIDUAL	80.10	256.86
REFINERY GAS	68.63	189.83
DIESEL	77.10	236.70
SUBTOTAL	231.93	701.19
	GAS	
DISTRIBUTED GAS	347.38	806.54
SUBTOTAL	347.38	806.54
	SOLIDS	
INDUSTRIAL GAS	6.95	16.24
SUBTOTAL	6.95	16.24
TOTAL	586.26	1523.97

Table I.2.2.11 Fuel consumption and CO_2 emission due to own consumption in the energy sector.

Table I.2.2.12 shows the total CO_2 emissions from the conversion activity. The emisssions due to liquid fuel consumption is 3229.99, from gas fuel is 980.88 Gg, and from solid fuels 1014.47 Gg. A total of 5225.35 Gg is obtained.

TOTAL CO_2 EMISSION FROM CONVERSION ACTIVITY

FUEL	CONSUMPTION (KTOE)	EMISSION CO_2 (Gg)
	LIQUID	
CRUDE OIL	49.04	149.06
GASOLINE	3.50	10.05
KEROSENE	2.60	7.74
RESIDUAL	420.20	1347.50
REFINERY GAS	68.63	189.83
DIESEL	497.00	1525.80
SUBTOTAL	1040.97	3229.99
	GAS	
DISTRIBUTED GAS	422.47	980.88
SUBTOTAL	422.47	980.88
	SOLID	
COAL	3.02	11.72
COKE	13.77	61.11
INDUSTRIAL GAS	6.95	16.24
WOOD	185.81	742.02
BAGASSE	45.40	183.38
SUBTOTAL	254.95	1014.47
TOTAL	1718.39	5225.35

Table I.2.2.12 Fuel consumption and CO_2 emissions from conversion activity.

Figure I.2.2.6 shows the percentage contribution of the emission by each subsector and by type of fuel. It can be observed that the electricity generation sector emits 52% of the total emissions in the Conversion activity. In this activity the use of petroleum based fuels emits 61.8% of the total.

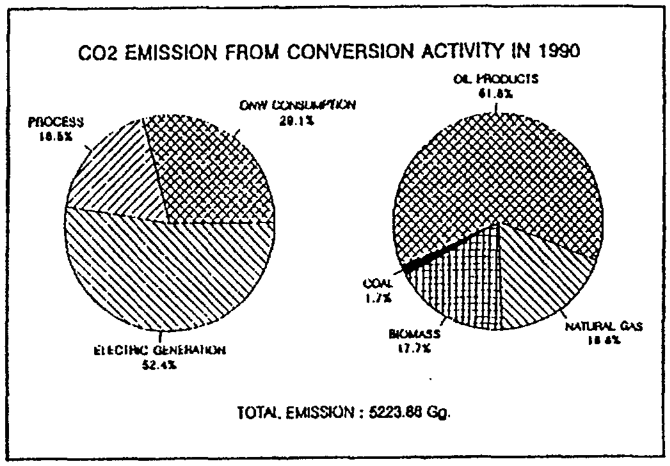

Fig. I.2.4.5 Percentage contribution of CO_2 emission from the conversion activity.

I.2.3 TRANSPORTATION SECTOR

From the pollution and development point of view, the transportation is an important sector for Peru. Peru has particular characteristics due to it geography and distribution of its population in three main regions: the Coast in which are the main cities, the Highlands, a mountainous territory that does not have enough communication ways and where the small cities are widely separated and the Jungle which do not present great development. For these reasons, transportation is mainly concentrated in the Coast specially in Lima, accounting it 75% of the automobile inventory.

For theses reasons, it is necessary to carry out detailed studies about the Industrial and Transportation sectors in Lima as well as in other cities of the Coast, considering them as great CO_2 emitters.

In this section, we present the national statistics of the automobile inventory, air and sea transportation as well as fuel and non energy products distribution, the estimates of the Inventory for the Transportation Sector and the analysis of the results.

I.2.3.1 FUEL DISTRIBUTION FOR THE TRANSPORTATION SECTOR

In 1990, The only company that was in charge of the distribution of fuels and non energy petroleum products was PETROPERU S.A. This company is in charge of the oil supply for all the sectors among them the transportation sector. This supply is accomplished through the direct sell of the product to consumers, gas stations and others (5)

I.2.3.1.1 Direct sell to the Transportation sector

PETROPERU was the company in charge of the distribution of petroleum fuels. It reports the quantities (Tones) of fuel and non energy products that sells directly to each type of transportation: Railway, roadway, National and Foreign air and sea transportation. (50 The quantities of its sales are shown in table 1.2.3.1

I.2.3.1.2 Sales through gasoline stations and others suppliers

PETROPERU reports also about the fuel and non energy products sales through gas stations and other suppliers. The reports includes the PETROPERU gas stations as well as private gas stations and other minor suppliers.

In 1990, there were 1446 gas stations that sold fuels and lubricants (non energy products), from which 1340 gas stations (93%) belonged to private companies and 106 (7%) to PETROPERU. Table I.2.3.1 and figure I.2.3.1 show the fuel sales for 1990.

SALE OF FUELS TO THE TRANSPORTATION SECTOR
UNITS: Barrels and kTOE

DISTRIBUTION	AVIAC. GASO.	GASOL 90 & 95 WP	GASOL. 84 82	JET FUEL	DOM. KEROS.	DIESEL1	DIESEL2	RESI. 5	RESI. 6
SERVICE STATION (GAS STATION)									
	0	1226324	8158187	3	5714	440524	6026722	0	0
DIRECT SALES FROM PETROPERU S.A. TO TRANSPORTATION SECTOR									
RAILWAY	0	0	1841	0	7	63	150455	0	9484
ROAD	0	103	4856	0	46	2116	565705	71	137701
NATIONAL AIR	14649	920	2524	1030829	0	37	4353	0	0
INTERNATIONAL AIR	124	0	0	632031	0	0	0	0	0
MARIT. NATIONAL	0	3	3583	0	2053	580	296121	150320	382625
MARIT. INTERN.	0	0	0	0	0	0	14747	0	2856
TOTAL	14773	1227350	8170991	1662858	7820	443320	7058103	150391	532666
TOTAL (KTOE)	1.80	149.74	996.86	221.16	1.04	61.18	974.02	22.11	78.30
Conversion factor (KTOE/10^3 bals.)	0.122	0.122	0.122	0.133	0.133	0.138	0.138	0.147	0.147

Table I.2.3.1. Sales of fuel from PETROPERU S.A. in 1990 [5].

Table I.2.3.1 presents fuels that have the same conversion factor from volumetric units to energy units. For example: Aircraft gasoline has a conversion factor of 0.122 ktoe/1000 bbls, it is the same for the case of other gasolines. Taking into account this fact, the fuel consumption from the transportation sector has been divided as follows: motor gasoline, kerosene, jet fuel, residual oil and diesel.

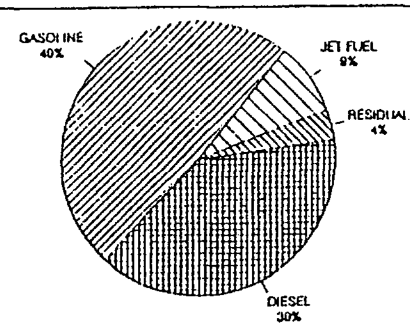

Fig. I.2.3.1 Sale of fuel by PETROPERU S.A. to Transportation sector.

I.2.3.2 FUEL CONSUMPTION OF THE TRANSPORTATION SECTOR

Table I.2.3.2 shows the national and International fuel consumption (Oil bunkers) distributed by gas stations and others suppliers. In relation to the non energy products, it has bedn considered the sales of national and foreign products. It is important to consider that in such table, it has been considered only 50% of non energy products sold according to the methodology about the STORAGE COAL ESTIMATION, AUXILIARY WORKSHEET FOR THE ESTIMATION OF THE STORAGE OF COAL [2].

UNITS: kTOE

DISTRIBUTION/ PRODUCTS	GASOLINE	JET FUEL	DIESEL	RESIDUAL	TOTAL ENERGY	LUBRI.	KEROSENE	BITUM.	TOTAL NON ENERGY	TOTAL
(GAS STATION AND OTHERS *)	1144.91	0.88	892.48	0.00	2038.38	10.17	0.76	5.46	16.40	2054.78
- RAILWAY	0.22	0.00	20.77	1.39	22.39	0.33	0.00	0.00	0.33	22.72
- ROAD	0.60	0.00	78.36	20.25	99.22	0.67	0.01	0.08	0.76	99.98
- NATIONAL AIR	2.21	136.11	0.61	0.00	138.92	0.02	0.00	0.21	0.23	139.15
- INTERNATIONAL AIR	0.02	84.06	0.00	0.00	84.08	0.00	0.00	0.00	0.00	84.08
- MARITIME NATIONAL	0.44	0.00	40.94	78.34	119.73	0.36	0.27	0.00	0.63	120.35
- MARITIME INTERNATIONAL	0.00	0.00	2.04	0.42	2.45	0.00	0.00	0.00	0.00	2.45
TOTAL NAT. CONSUMPTION	1148.38	137.10	1033.16	99.99	2418.64	11.55	1.04	5.75	18.34	2436.98
TOTAL INTERNAT. CONSUMPTION	0.02	84.06	2.04	0.42	86.53	0.00	0.00	0.00	0.00	86.53
TOTAL	1148.40	221.16	1035.2	100.41	2505.17	11.55	1.04	5.75	18.34	2523.51
Conversion Factor (KTOE/1000 Barrels)	0.122	0.133	0.138	0.147		0.138	0.133	0.138		

* Others distributors.

Table I.2.3.2 Energy and non energy products consumption for transportation sector

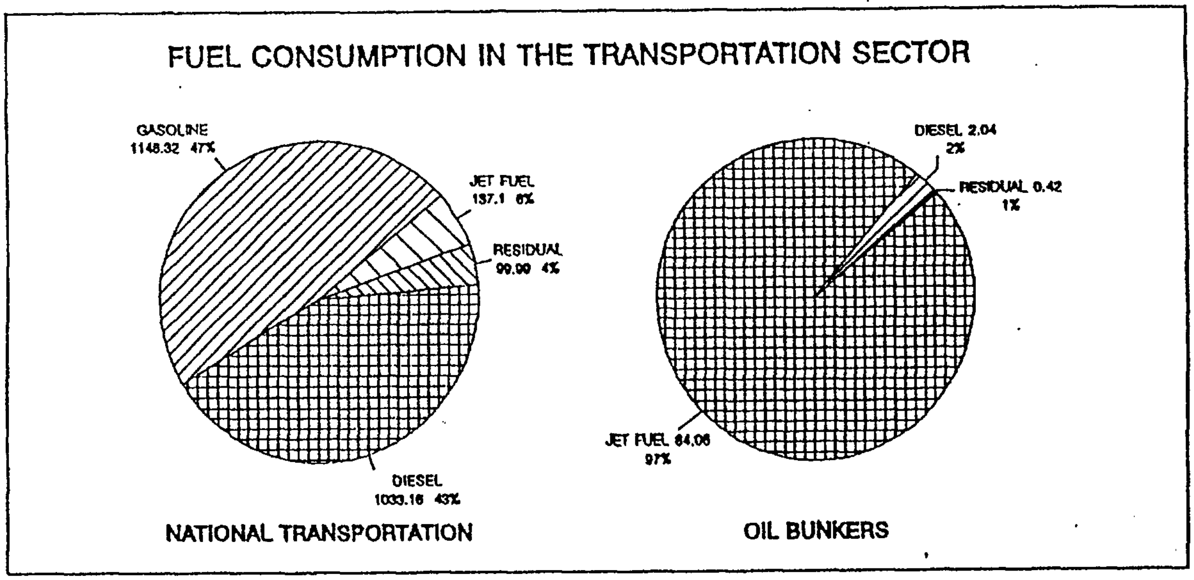

Figure I.2.3.2 Fuel consumption (kTOE) by National and International Transportation

I.2.3.3 NATIONAL TRANSPORTATION

The national transportation consist of three ways of communication : by air, by sea and by air. Table I.2.3.3 shows the types of transportation. Such table can also be applied to public and load transportation [10].

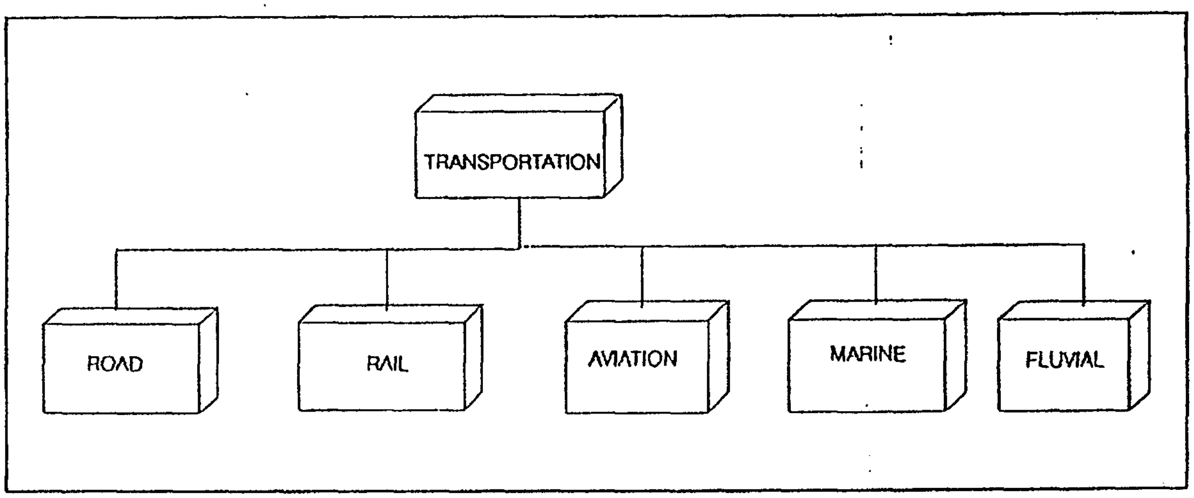

Fig. I.2.3.3 Composition of National Transportation.

I.2.3.3.1 National road transportation

Peru has a road network of 69942 Km. table I.2.3.3 shows in detailed the type of surface road wheeling of the road network in between 1985 and 1992. Among the main roads in Peru we have: Panamerican (2,600 km) which goes over the Peruvian coast, La Marginal de la Selva which connects many places of the jungle region. In respect to the Peruvian Railway network, Peru has a railway line that connects the capital with Huancayo and another line which connects Cuzco with other cities of the region.

NATIONAL ROAD NETWORK

NATIONAL ROAD NETWORK	ROAD NETWORK LENGTH : Kms.					
	1985	1986	1987	1990	1991	1992
TOTAL	68363	69942	69942	69942	69942	69942
NATIONAL	14337	15690	15692	15692	15692	15692
DEPARTAMENTAL	15449	14445	14444	14444	14444	14444
VECINAL	38577	39807	39806	39806	39806	39806
ASPHALTING	7325	7459	7459	7564	7459	7624
NATIONAL	5256	5634	5635	5740	5635	5800
DEPARTAMENTAL	1341	1058	1058	1058	1058	1058
VECINAL	728	767	766	766	766	766
ROADBED	13627	13538	13538	13475	13538	13484
NATIONAL	6315	7020	7021	6958	7021	6967
DEPARTAMENTAL	4833	4096	4096	4096	4096	4096
VECINAL	2479	2422	2421	2421	2421	2421
NO ROADBED	15853	15940	15940	15898	15940	15867
NATIONAL	2290	2592	2594	2552	2594	2521
DEPARTAMENTAL	6410	6119	6118	6118	6118	6118
VECINAL	7153	7229	7228	7228	7228	7228
TRAIL	31558	33005	33005	33005	33005	32967
NATIONAL	476	444	442	442	442	404
DEPARTAMENTAL	2865	3172	3172	3172	3172	3172
VECINAL	28217	29389	29391	29391	29391	29391

Source: General office of Method and Systems. MINISTERIO DE TRANSPORTES, COMUNICACIONES, VIVIENDA Y CONSTRUCCION [12].

Table I.2.3.3 National road network length according to the type of surface and wheeling.

I.2.3.3.1.1 Road Transportation

Table I.2.3.3 shows that during 1990 Peru had a national paved wheeling surface of 5740 Km and a departmental and a local network of 1058 and 766 Kms respectively.

Peru has a national roadbed surface of 6958 km,a departmental one of 4096 km, and a local one of 7228 Km.

Table I.2.3.4 shows the national automobile inventory of 1987-1990 according to the types of vehicles. The automobiles were classified into automobiles (56%), Pickups (17%), Station wagons (8%), Buses (4%), Panel light Trucks (1%) and light towings (1%). Figure Y.2.3.4 shows the automobile Inventory of 1990.

NATIONAL AUTOMOTIVE PARK ACCORDING TO VEHICLE TYPE

VEHICLE TYPE	1987	1988	1989	1990	1991	1992
TOTAL NATIONAL	610813	616578	612249	605550	623947	672957
AUTOMOBILES	332874	332158	328638	324440	333730	352912
STATION WAGON	44548	44643	44152	43715	45331	49439
PICKUP	96644	100002	100388	99733	102823	106672
RURAL LIGHT TRUCKS	30026	30947	30964	30702	33524	47111
PANEL LIGTH TRUCKS	9001	8895	8728	8564	8751	9183
BUSES	20174	20613	20612	20605	21239	27270
TRUCKS	67302	68280	67566	66567	66812	67648
TOWING	4649	4993	5036	5036	5472	5902
LIGTH TOWING	5595	6047	6165	6188	6465	6820

Table I.2.3.4 Automotive park according to vehicle type [13].

Table I.2.3.4 and Figure I.2.3.5 show the Peruvian automobile inventory according to the departments of the country,. It is duty to considered that Lima accounts the greatest number of vehicles (66%) followed by Arequipa (5%), Junin (5%0, La libertad(4%), Piura (4%) and Lambayeque (3%).

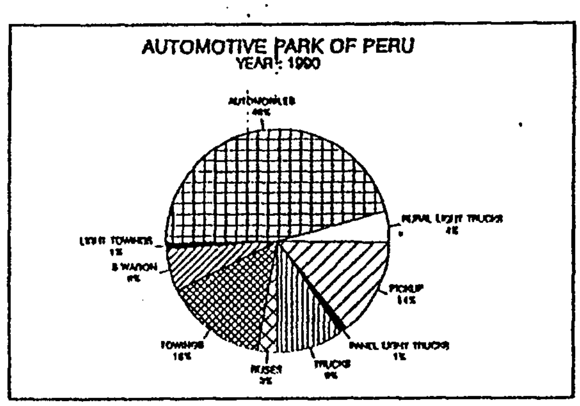

Fig. I.2.3.4 National automotive park according to vehicle type for the year 1990.

AUTOMOTIVE PARK BY DEPARTMENTS 1987 - 1992
(UNITS)

DEPARTAMENTS	YEARS					
	1987	1988	1989	1990	1991	1992
TOTAL	610813	616578	612249	605550	623947	672957
AMAZONAS	707	769	771	768	792	833
ANCASH	10813	10807	10649	10502	10537	10727
APURIMAC	823	851	859	862	924	1053
AREQUIPA	32457	32813	32415	32098	32775	33829
AYACUCHO	2150	2133	2113	2085	2089	2113
CAJAMARCA	3622	3739	3683	3622	3608	3621
CUZCO	11618	11803	11806	11718	11818	12583
HUANCAVELICA	404	403	403	400	421	465
HUANUCO	9244	9253	9170	9067	9003	8988
ICA	11955	11834	11683	11515	11530	11708
JUNIN	27625	28037	27916	27617	27384	27364
LA LIBERTAD	21763	21828	21706	21427	21935	22878
LAMBAYEQUE	20498	20691	20419	20108	20319	20972
LIMA	400130	404406	401842	397623	413318	456023
LORETO	4634	4790	4735	4666	4670	4716
MADRE DE DIOS	273	302	321	330	352	382
MOQUEGUA	2648	2609	2575	2541	2636	2779
PASCO	2120	2114	2091	2081	2064	2156
PIURA	22289	22097	21790	21436	21773	22442
PUNO	7233	7264	7256	7195	7436	7833
SAN MARTIN	3046	3090	3126	3121	3277	3477
TACNA	9756	9785	9768	9684	10014	10418
TUMBES	1736	1727	1719	1704	1753	1880
UCAYALI	3269	3433	3433	3402	3519	3717

Table 1.2.3.5 National automotive park by departments [13].

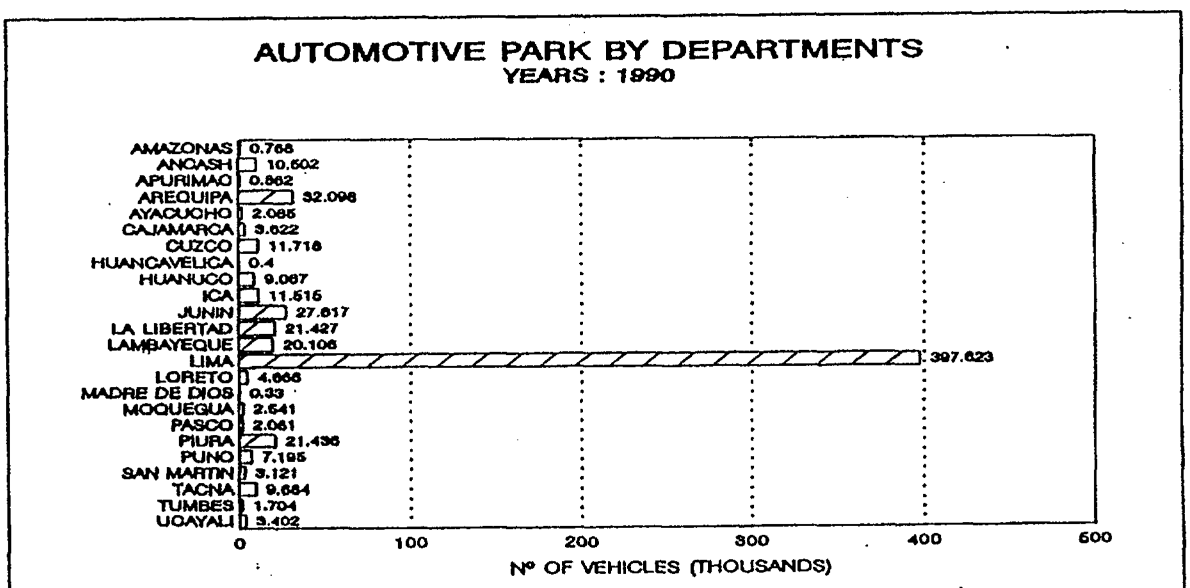

Fig. I.2.3.5 Automotive park of 1990 in the departments of Peru.

Figure I.2.3.6 shows an statistical sample of diesel and gasoline vehicles registered til 1990. Such sample accounts 30% of the automobile Inventory of Lima.

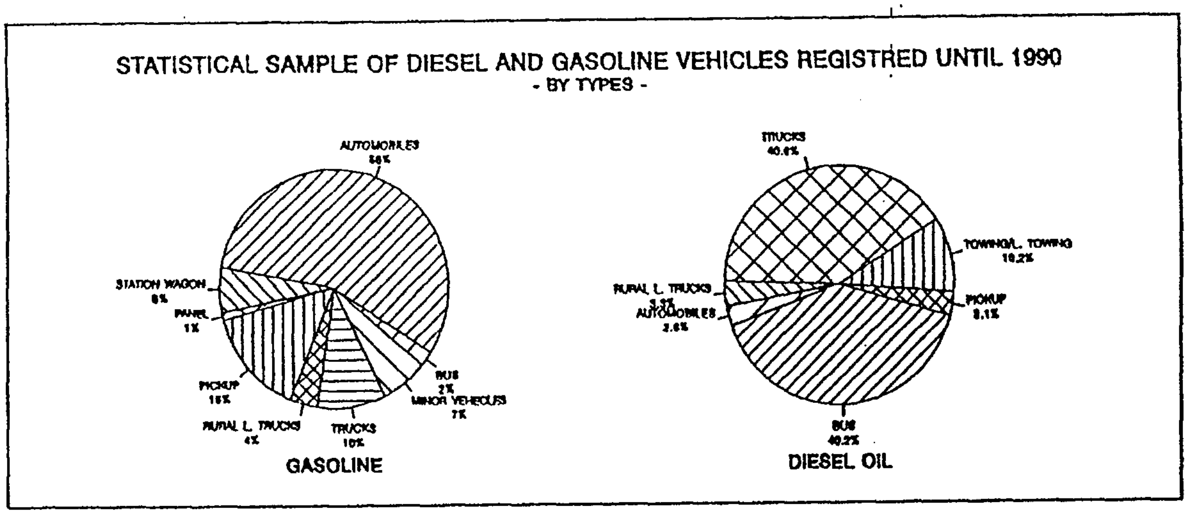

Fig. I.2.3.6 Types of gasoline and diesel vehicles registered at the department of Lima.

Another statistical sample of gasoline vehicles registered in 1990 is shown in Figure I.2.3.7. It was established that, Dodge, Ford, Honda, Nissan and Chevrolet are the most important brands. In respect to the vehicles that use diesel, the most important are: Volvo, Dodge and Ford (Figure I.2.3.8) [14].

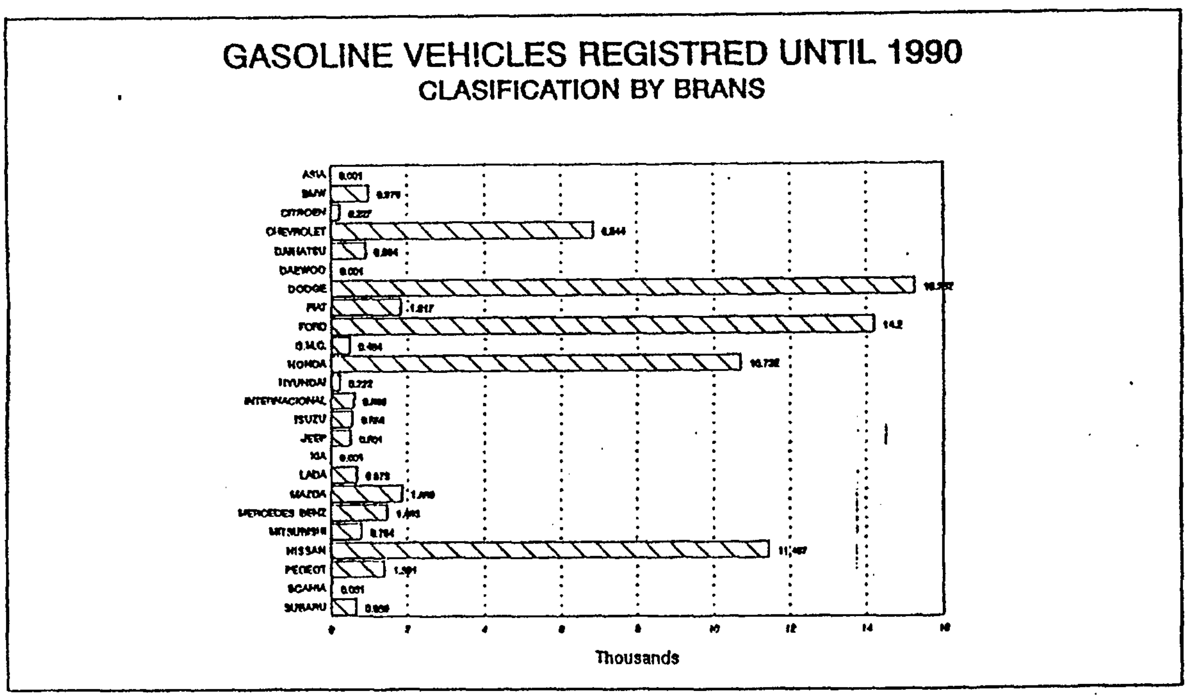

Fig. I.2.3.7 Gasoline Vehicles registered in the department of Lima until 1990.

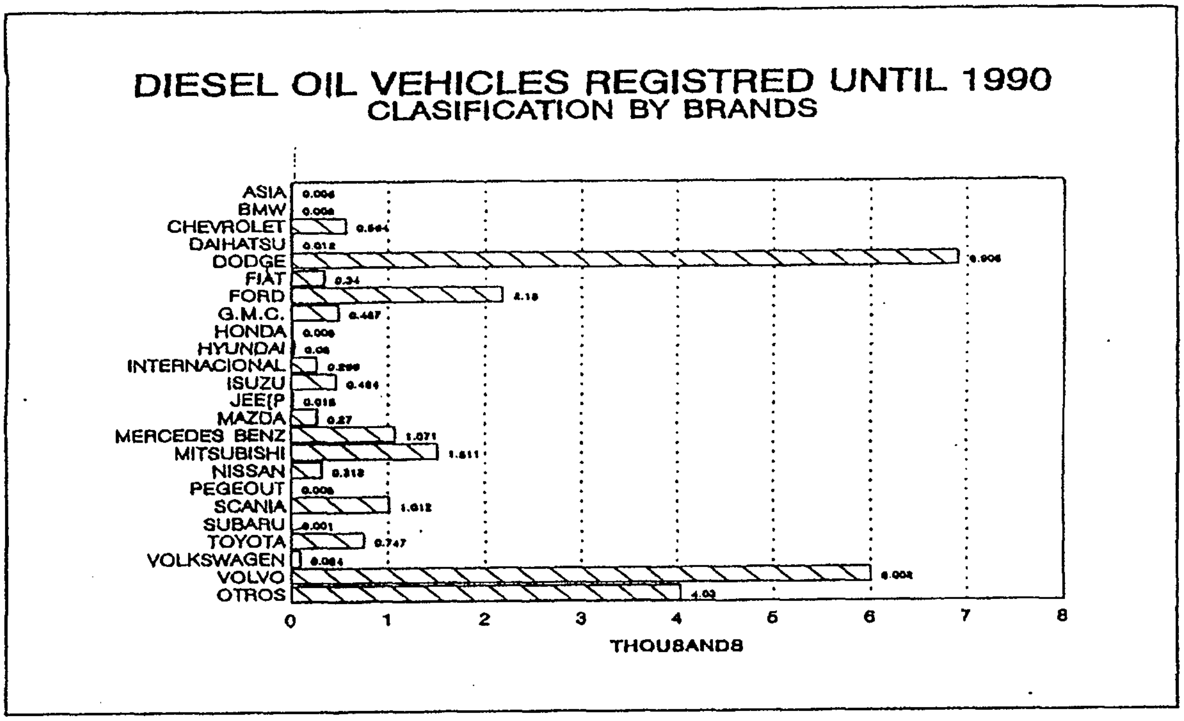

Fig. I.2.3.8 Diesel vehicles registered in the department of Lima until 1990.

I.2.3.3.1.2 Railway Transportation

Peru has a railway network which are owned by state companies such as: ENAFER and CENTROMINPERU, and by private companies such as: SOUTHERN PERU COPPER CO. The railway network lenght in 1990 [16] is shown in table I.2.3.6.

Table I.2.3.7 shows the railway inventory by each company as well as by each type of vehicle for the period between 1984-1991. Figure I.2.3.9 shows the national railway inventory of locomotives.

ENTERPRISE AND LENGTH OF RAIL	TOTAL (Km)	MAIN RAILWAY LINE(Km)	SECONDARY RAILWAY LINE (Km)
	YEAR : 1990		
ENAFER S.A.	1923	1704	219
CALLAO - HUANCAYO	488	383	105
HUACAYO-HUANCAVELICA	140	129	11
MATARANI - CUZCO	1030	946	84
CUZCO - QUILLABAMBA	196	184	12
TACNA - ARICA	69		
		62	7
CENTROMIN PERU	271	212	59
LA OROYA - C. DE PASCO	187	132	55
PACHACAYO - CHAUCA	84	80	4
SOUTHERN PERU COPPER CO.	240	186	54
TOQUEPALA - ILO CUAJONE	240	186	64
TOTALS	2434	2102	332

Table I.2.3.6 Railway network of Peru [12].

PERU : RAILWAY PARK, ACCORDING TO ENTERPRISE AND TYPE OF VEHICLE (1984-1991)								
ENTERPRISES AND/OR TYPES OF VEHICLES	1984	1985	1986	1987	1988	1989	1990	1991
TOTAL								
LOCOMOTIVES	116	115	114	119	121	119	119	118
COAH AND RAILWAY CAR	53	78	78	80	80	80	80	80
PASSENGER CARS	184	217	189	190	187	187	187	187
FREIGTH CARS	3478	3487	3438	3792	3808	3804	3693	3672
ENAFER S.A.	BY ENTERPRISE							
LOCOMOTIVES	88	90	89	93	95	95	95	95
COAH AND RAILWAY CAR	32	57	57	59	59	59	59	59
PASSENGER CARS	147	180	152	153	150	150	150	150
FREIGTH CARS	2136	2134	2085	2439	2444	2444	2444	2444
CENTROMIN PERU	BY ENTERPRISE							
LOCOMOTIVES	14	14	14	14	14	12	12	11
COAH AND RAILWAY CAR	21	21	21	21	21	21	21	21
PASSENGER CARS	37	37	37	37	37	37	37	37
FREIGTH CARS	696	696	696	696	696	696	696	696
SOUTHERN PERU COPP.CO.	BY ENTERPRISE							
LOCOMOTIVES	14	11	11	12	12	12	12	12
FREIGTH CARS	646	657	657	657	656	656	453	434

Table I.2.3.7 Railway park according to enterprises and type of vehicle fo the period (1984-1991) [12].

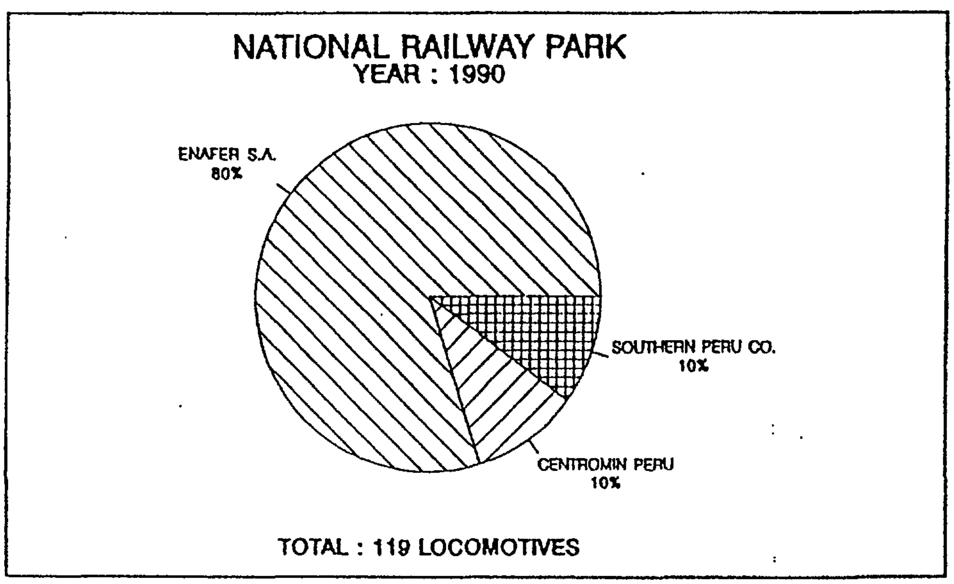

Fig. I.2.3.9 Structure of national railway park in 1990.

I.2.3.3.2 Air transportation

National air Transportation is classified in: Commercial air service, Tourist Service and Especial Service. Table I.2.3.8 shows the aircraft inventory for the period between 1985-1992 and Figure I.2.3.10 shows the air inventory in 1990.

PERU: NATIONAL AIRCRAFT PARK, ACCORDING TO SERVICE TYPE AND PROPULSION SYSTEM (1985-1992)								
TYPE OF SERVICE \ YEARS	1985	1986	1987	1988	1989	1990	1991	1992
TOTAL	167	164	177	175	182	151	177	133
HELIX	120	120	123	119	128	106	106	77
TURBO HELIX	23	21	26	28	30	22	29	15
TURBO REACTOR	24	23	28	28	24	23	42	41
COMMERCIAL AIR	82	81	95	96	103	100	123	101
REGULAR	34	33	34	36	33	23	29	31
TURBO HELIX	12	12	12	14	14	6	7	1
TURBO REACTOR	22	21	22	22	19	17	22	30
NON REGULAR	48	48	61	60	70	77	94	70
HELIX	44	44	46	45	54	58	55	46
TURBO HELIX	4	4	10	10	12	14	20	14
TURBO REACTOR			5	5	4	5	19	10
TOURIST	12	13	13	14	16	15	12	10
HELIX	12	13	13	14	16	15	12	10
ESPECIAL	73	70	69	65	63	36	42	22
HELIX	64	63	64	60	58	33	39	21
TURBO HELIX	7	5	4	4	4	2	2	
TURBO REACTOR	2	2	1	1	1	1	1	1

Table I.2.3.8 National aircraft park for the period 1985-1992 [12].

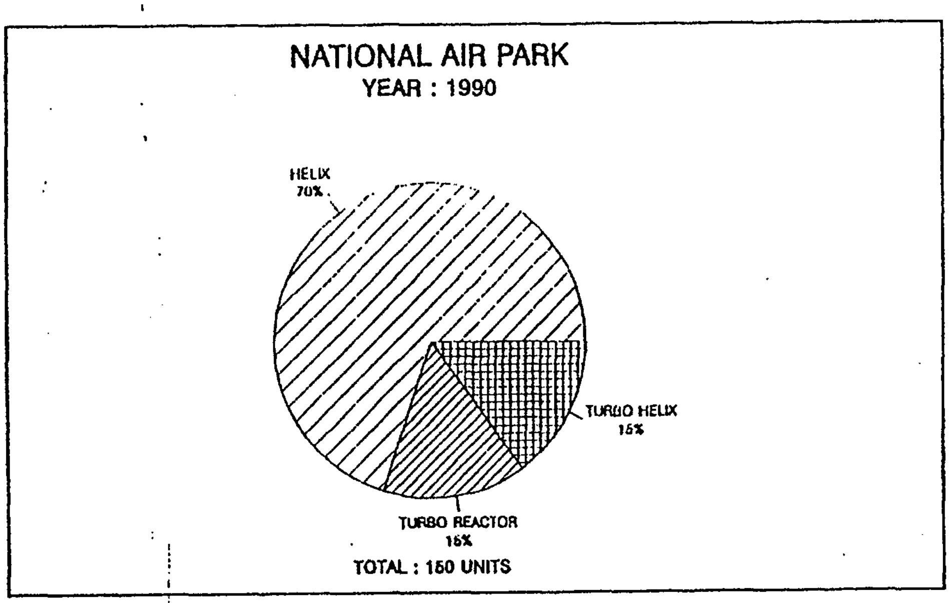

Fig I.2.3.10 Structure of national aircraft park in 1990.

I.2.3.3.3 Aquatic Transportation

Aquatic Transportation in Peru comprises by sea, river and lake transportation. Sea transportation is managed by the government and the private sector, air transportation by the private sector and lake transportation by the government and private sector. In this section we have included the units of load transportation. The fishing units are considered in the Fishing sector.

Table I.2.3.9 shows the aquatic inventory according to the way of transportation, to the private sector and to the type of ship for the period between 1985-1992 (12).

Figure I.2.3.11 shows the units according to the company management in 1990. The number of units of the river transportation is greater than the ones in the sea and lake transportation.

PERU: AQUATIC PARK ACCORDING TO TRANSPORT MODE, PRRIVATE SECTOR AND KIND OF SHIP 1985-1992								
PROPERTY SECTOR AND	YEARS							
KIND OF SHIP	1985	1986	1987	1988	1989	1990	1991	1992
TOTAL	588	608	550	643	649	647	545	562
MARITIME	63	57	55	53	52	51	30	34
GOBERNMENT	32	25	26	26	25	25	9	19
FREIGHT SHIP	16	10	10	10	10	10	2	6
GAS (TRANSPORT) SHIP	1	1	1	1	1	1	1	1
LOAD IN BULK SHIP A	3	3	3	3	3	3	1	1
MULTI - USE	3	1	1	1				
SEMI - CONTAINER	1	1	1	1	1	1	1	1
TANK SHIP	8	9	10	10	10	10	4	10
PRIVATE	31	32	29	27	27	26	21	15
FREIGHT SHIP	12	14	13	12	11	10	9	4
FRIGORIFIC	1	1	1	1	1	1	1	1
LOAD IN BULK SHIP	7	7	5	5	5	5	3	2
MULTI - USE	1	1	1					
SEMI - CONTAINER	4	4	4	3	4	5	4	4
TANK SHIP	5	4	4	4	4	3	3	3
ROLL ON ROLL	1	1	1	1	1	1	1	1
TOURIST				1	1	1		
RIVER	522	548	492	509	516	515	512	525
PRIVATE	522	548	492	506	513	512	512	525
TOURIST PRIVATE				3	3	3		
LAKE	3	3	3	81	81	81	3	3
GOVERNMENT	3	3	3	3	3	3	3	3
PRIVATE TOURIST				78	78	78		

Table I.2.3.9 National aquatic park [12].

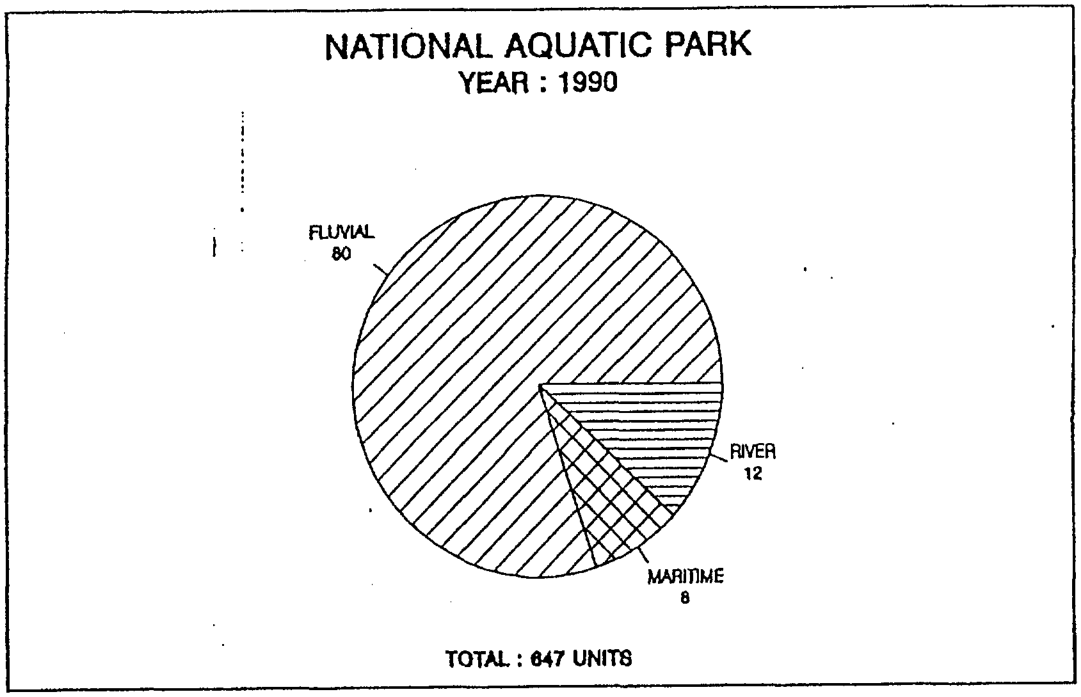

Fig. I.2.3.11 National aquatic park.

I.2.3.4 ESTIMATES OF THE GREENHOUSE INVENTORY FOR THE TRANSPORTATION SECTOR.

The methodology of the Greenhouse inventory Workbook"(IPCC, Draft Guide lines for National Greenhouse Gas Inventories) Vol I (2) has been used to estimate the inventory of the present study.It has been used also in the second quarterly report [8].

The data taken from the Distribution Resource of PETROPERU S.A has been used for the Inventory of the present study, determining in this way the Updated Energy balance of 1990 (table I.2.3.1) (15). Table I.2.3.10 shows the CO_2 inventory of the Transportation Sector including the national emissions as well as the oil bunkers consumption. Annex 5 shows a detailed calculation of

CO_2 EMISSION IN THE TRANSPORTATION SECTOR

NATIONAL			
FUEL TYPES	(kTOE)	Gg de CO_2	(ton CO_2)/TOE
MOTOR GASOLINE	1148.38	3298.65	2.872
JET FUEL	137.10	406.31	2.964
DIESEL	1033.16	3171.81	3.070
RESIDUAL	99.99	320.65	3.207
NON ENERGY PRODUCTS	18.34	34.13	1.861
TOTAL NATIONAL	2436.98	7231.66	-----
INTERNATIONAL (OIL BUNKERS)			
AVIATION GASOLINE	0.02	0.06	2.872
JET FUEL	84.06	249.12	2.964
DIESEL	2.04	6.26	3.070
RESIDUAL	0.42	1.31	3.207
TOTAL OF OIL BUNKERS	86.53	266.76	-----

Tabla I.2.3.10 CO_2 emission due energy and non energy products combustion in the transportation sector.

such estimations. The fuels have been divided into: Jet fuel, Diesel oil, Residual oil and non energy products used in activities that emit CO_2.

Figure I.2.3.12 shows the CO_2 emissions (%) of each type of fuel consumed by the National transportation as well as the participation of CO_2 emission corresponding to Aircraft and international navigation (BUNKERS).

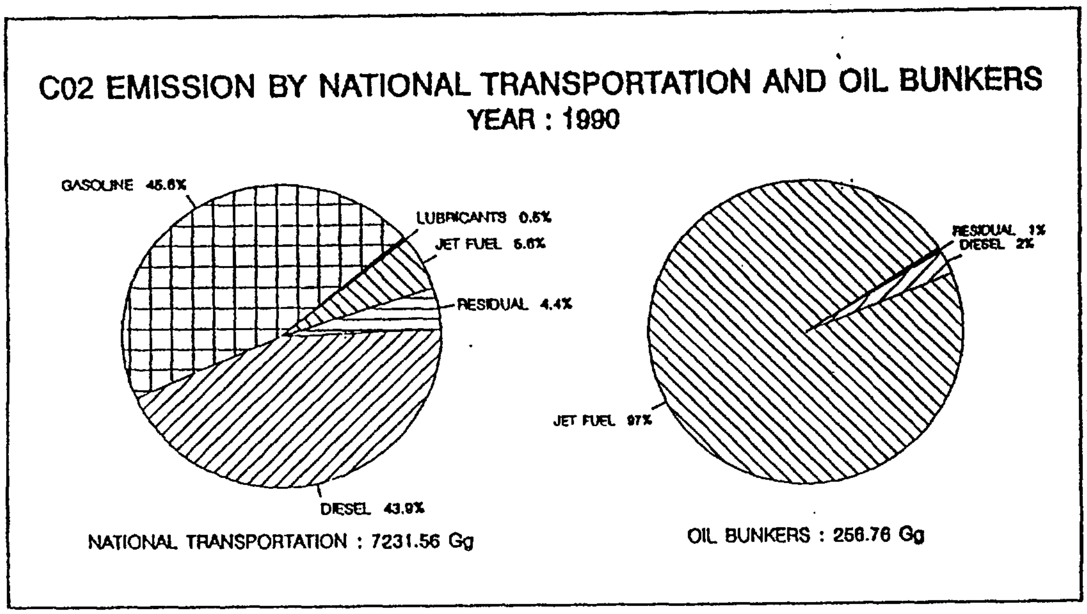

Fig. I.2.3.12 CO_2 National emission for transportation setor 1990.

I.2.3.5 ANALYSIS OF THE RESULTS

During 1990, the transportation sector consumed the following energy products: Gasoline (45.6%), Diesel (43.9%), Jet fuel (5.6%) and Residual (4.4%). Therefore, there was a demand of non energy products (18.34% ktoe) , accounting lubricants the major consumption (63%), Bitumen (31%) and Kerosene (6%).

Each type of transportation consumes the different fuels according to its needs, although it can be observed that each type of consumer use mainly one type of fuel. It can also be noted that, air transportation uses only JET FUEL and GASOLINE for the aircraft. The railway transportation uses mainly DIESEL OIL and the road transportation GASOLINE and DIESEL.

In relation to the Automobile Inventory , in 1990 the traffic of vehicles was constituted of automobiles (17%), pickups (12%), trucks (12%) and other vehicles. In respect to the geographical distribution, the coast has the major number of vehicles. Being the most important departments: Lima (66%), La libertad (4%), Piura (4%), Lambayeque (3%). There are vehicles that use gasoline and diesel oil. Dodge, Ford, Nissan and Honda are the most important brands that use gasoline. Pickups and Trucks use mainly diesel oil. The most important brands of vehicles are: Dodge, Ford, Mitsubishi and Volvo.

The National consumption of fuels of the transportation sector in 1990 was 2437.00 kTOE which together with oil bunker was 86.54 kTOE. CO_2 emissions from national consumption of the transportation sector was 7197.32 Gg. This amount accounts 36.1% of the fuels and non energy products used by all the sectors which are part of the Peruvian market.
Roadway transportation is the greatest CO_2 emitter, this is due to the high gasoline consumption (82.84 and 95 octane with lead and 90 octane without lead, diesel oil 1 and 2).

From the study about the age of the automobile Inventory, we have found that a great number of vehicles had been made before 1977 and are older than 17 years old.

I.2.4 INDUSTRIAL SECTOR

The analysis of the industrial sector is related to the manufacturing production process which includes the following industrial activities:

- Food, Drink and Tobacco (CIIU 31)
- Textile Industry (CIIU 320)
- Wood industry (CIIU 33)
- Paper manufacturing (CIIU 34)
- Chemical Process Industry (CIIU 35)
- Industry of non energy metal minerals (CIIU 36)
- Basic Metal Industry (CIIU 37)
- Industry of Metal Products (CIIU 38)
- Other manufacturing Industries (CIIU 39)

CIIU refers to the International Industry Classification

Taking into account GDP generation between 1983-1993, this sector account for 16% of such generation. The monthly Industrial production ratio (SNI Peruvian Industry Society) for 1990 showed negative changes in all the Industry sectors. In the industrial sector during 1990, the production decreased due to a minor use of the installed capacity wich was a consequence of the economical crisis [17].

It is also duty to consider that, from the total number of industrial companies in the manufacturing sector, 45% are located in Lima and Callao.

Moreover, the energy used by the different industrial activities is from fossil fuels such as diesel oil, residual oil, coal and other fuels which are mainly used to generate electricity, direct heating., power and electrolysis.

In order to achieve the aims of our study "Greenhouse Gas Inventory" we have mainly considered the consumption of the following fuels: residual oil, diesel oil and coal. Table I.2.4.1 and figure I.2.4.1 show such consumption according to the industrial activities.

As it is shown in table I.2.4.2 and figure I.2.4.2 we have also considered the different manufacturing industries by departments. This table presents the consumption rate of residual oil, diesel oil, coal, wood, motor gasoline, jet fuel, distributed gas and industrial gas. It can be observed that Lima is the major fuel consumer because of the fact that, greatest part of the industrial companies have their headquarters. Callao, considered as an industrial area of Lima, shows also a great consumption.

FUEL CONSUMPTION FROM THE INDUSTRIAL SECTOR - 1990 (KTOE)

Fuels/ SubSectors	Coal	Wood	Gasoline	Kerosene	Diesel	Residual Fuel	Dist.Gas	Ind. Gas	Lubricants	TOTAL
Foods, drink and Tabacco		444.61	0.97	0.11	24.72	120.21				591.62
Textile industrial			0.30	0.08	15.15	52.01				67.54
Wood industry			0.20	0.04	1.16					1.40
Paper industry			0.30	0.24	8.44	107.45				116.43
Chemical process industry			0.48	0.57	5.95	53.07	28.40			88.47
Non Metallic minerals industry	4.82		0.10	0.18	14.94	199.35			2.10	221.49
Basic Metallic industry	43.68			0.04	22.04	27.12		9.40		102.28
Metallic products indus.				0.14						0.14
TOTAL	48.60	444.61	3.35	1.40	92.40	559.20	28.40	9.40	2.10	1189.4

Table I.2.4.1 Fuel consumption of the different activities of the industry sector.

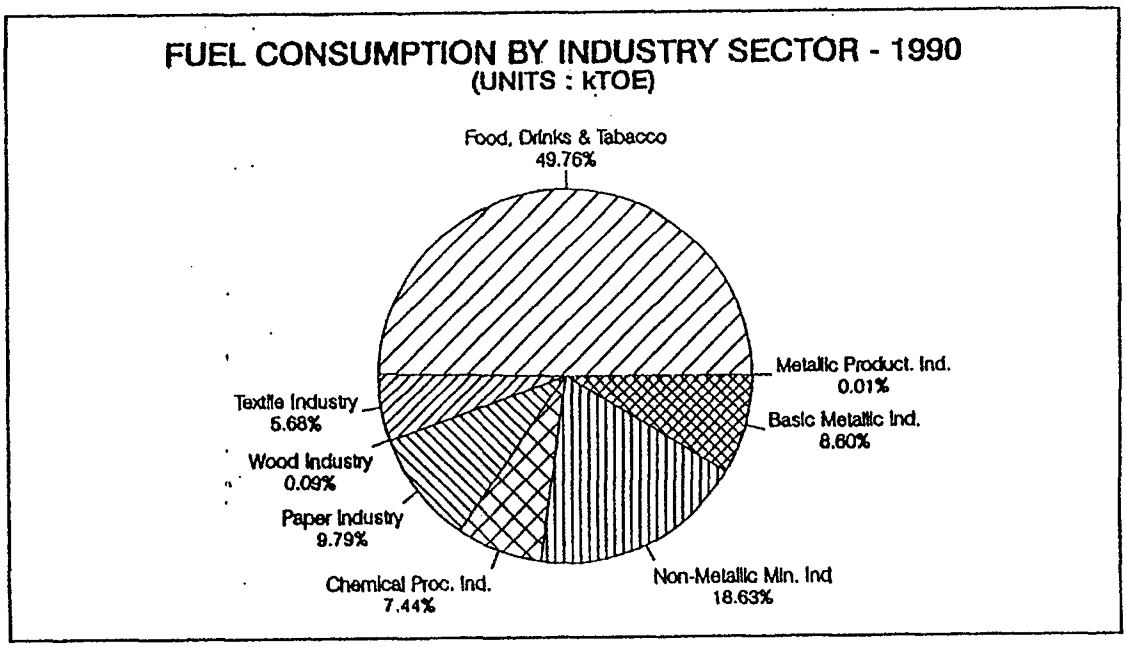

Fig. I.2.4.1 Fuel consumption of the different activities of the industry sector.

FUEL CONSUMPTION IN THE INDUSTRY SECTOR BY DEPARTMENTS - 1990
(kTOE)

DEPARTMENTS	Coal	Gasoline	Kerosene	Diesel	Residual	Distr. Gas	Ind. Gas	TOTAL
ANCASH	43.97	0.30		14.65	30.93		9.40	99.25
AREQUIPA				3.45	42.89			46.34
CAJAMARCA				0.25	1.04			1.28
CALLAO			0.24	7.10	59.10			66.41
CUZCO				1.70	0.00			1.70
ICA				0.74	8.10			8.84
JUNIN	0.23			0.85	41.64			42.72
LA LIBERTAD		0.10		3.78	82.09			85.97
LAMBAYEQUE				2.81	6.27			9.09
LIMA	4.30	2.75	1.12	42.43	279.01			329.61
LORETO		0.20	0.04	0.79				1.03
PIURA				8.83	6.34	28.40		43.57
PUNO				3.05				3.05
TACNA					0.49			0.49
UCAYALI				1.97	1.30			3.27
TOTAL	48.50	3.35	1.40	92.40	559.20	28.40	9.40	742.65

Table I.2.4.2 Consumption of fossil solid, liquid and gaseous fuels by departments [17].

We have also considered the following departments and their most important companies: La Liberatad, Compañisa de cemento Pacasmayo (Pacasmayo Cement Company), Ancásh Sociedad de Paramonga (Paramonga Society), Arequipa, Compañia de Cemento Yura (Yura cement Company) and other fuel Consumer Industries

Therefore, according to the analysis of the fuel consumption from the manufacturing companies, the consumption rates of 1982 were compared with the ones of 1990 as it is shown in table I.2.4.3. From this table we can note some changes in Residual oil Consumption.

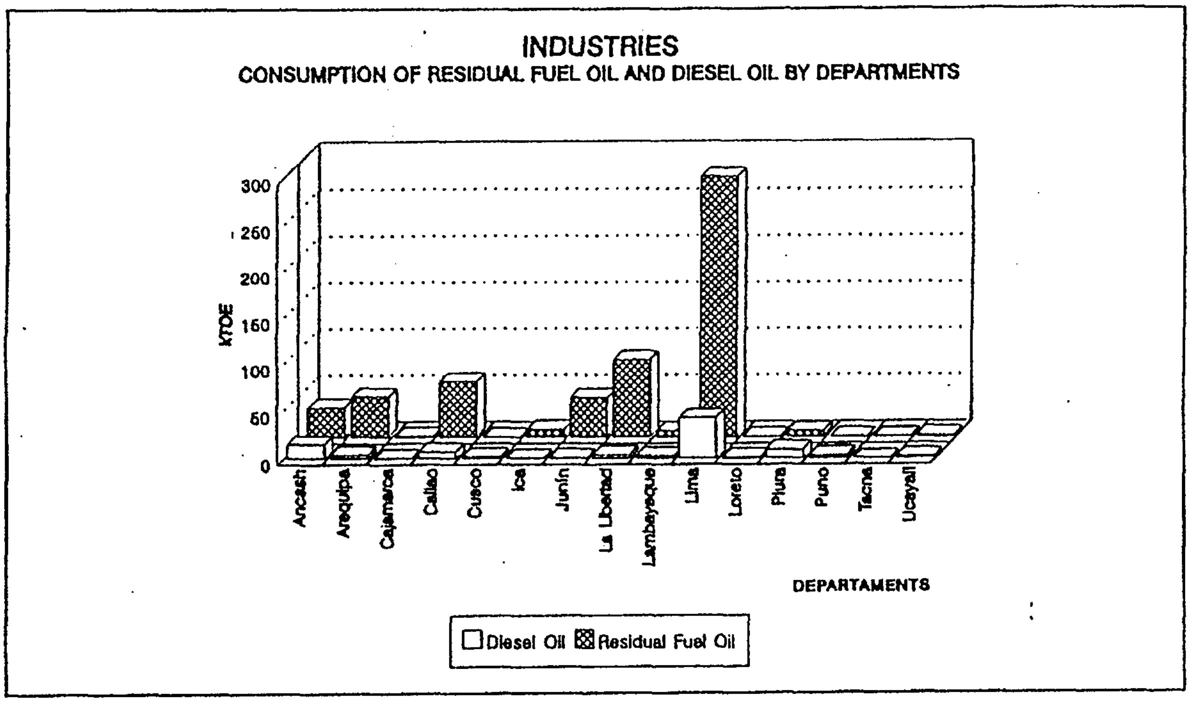

Fig. I.2.4.2 Energy products consumption.

MAIN ENTERPRISES THAT CONSUME FUEL
(TEP)

ENTERPRISES	1982				1990	
	Fuel	EE	Total	% Fuel	Fuel	% Fuel
SIDER PERU	123660	16450	140110	27.2	28814	9.6
CEMENTOS LIMA	101150	11040	112190	22.2	51846	17.3
BACKUS & JOHNSTON	0	0	0	0	8275	3.0
CEMENTOS PACASMAYO	53430	8020	61450	11.7	60748	20.3
CEMENTO ANDINO	52670	7700	60370	11.6	42717	14.2
SOCIEDAD PARAMONGA	51140	20860	72000	11.2	75509	25.2
BAYER INDUSTRIAL	26290	3250	29540	5.8	26978	9.0
FAB. TEJ. LA UNION	25290	3640	28930	5.6	3755	1.3
CIA. NAC. DE CERVEZA	21460	1930	23390	4.7	1292	0.004
TOTAL	455090	72890	527980	100	299934	100

Table I.2.4.3 Main industrial enterprises that consume fuel.

CO_2 emissions of the industrial sector for 1990 were 2355.5 Gg, from which 85% are from Residual oil Consumption. Table I.2.4.4 and figure I.2.4.3 show the percentage rate of the emissions due to industrial activities. It can be observed that non metal minerals industries (CIIU 36) and food and drink industries (CIIU 31) present the major rates.

CO_2 EMISSION FROM THE INDUSTRY SECTOR
UNITS : Gg.

Fuels/ SubSectors	Coal	Wood	Gasoline	Kerosene	Diesel	Residual	Dist. gas	Ind. gas	Lubrican.	TOTAL
Foods, drink and Tabacco		1775.51	5.66	0.33	75.89	385.49				2242.88
Textile industrial			0.86	0.24	46.51	166.79				214.40
Wood industry			0.57	0.12	3.56					4.25
Paper industry			0.86	0.71	25.91	344.57				372.06
Chemical process industry			1.38	1.70	18.27	170.18	65.94			257.47
Non Metallic minerals industry	18.71		0.29	0.54	45.87	639.27			6.38	711.06
Basic Metallic industry	169.54			0.12	67.66	86.97		21.97		346.26
Metallic products indus.				0.42						0.42
TOTAL	188.25	1775.51	9.62	4.17	283.67	1793.25	65.94	21.97	6.38	4148.74

Table I.2.4.4 CO_2 emission from each industrial activity.

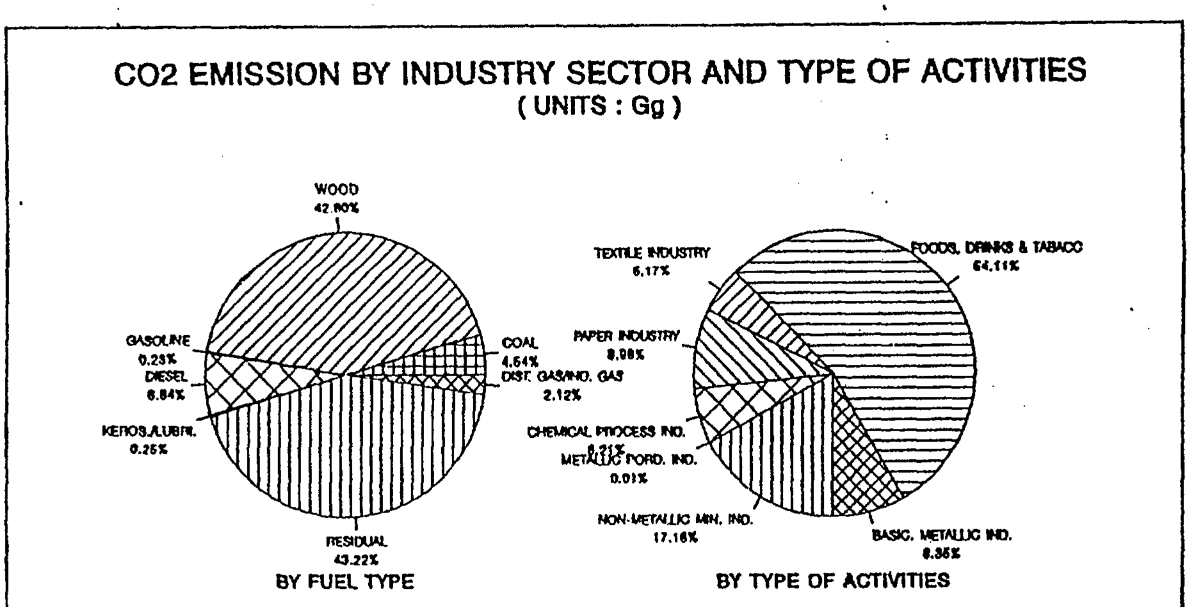

Fig. I.2.4.3 CO_2 emission according to fuel and industrial activity type.

I.2.5 OTHER USES SECTOR

I.2.5.1 Fuel consumption in the other uses sector

This sector includes the following subsectors: Public, Residential/ Commercial, Fishing, Agriculture and cattle/Agricultural Industry, Mines Metallurgy. Table I.2.5.1 shows the total energy consumption with and without biomass for the other uses sector and its subsectors. It can be noted that the Residential/Commercial subsector is the major consumer.

I.2.5.1 Fuel Consumption in the Residential/ Commercial subsector

Table I.2.5.2 shows the fuel consumption of the Residential/Commercial subsector. It can be observed that biomass accounts the major consumption in this subsector.

SUBSECTORS	WITHOUT BIOMASS		WITH BIOMASS	
	QUANTITY	%	QUANTITY	%
PÚBLIC	284.99	15.13	284.43	5.53
RESIDENTIAL COMMERCIAL	923.27	49.02	4068.17	78.98
FISHING	206.09	10.94	206.09	4.00
AGRIC. CATTLE/AGRIC. IND.	89.38	4.75	212.22	4.12
MINING	379.65	20.18	379.65	7.37
TOTAL	1883.38	100.00	5150.56	100.00

Table I.2.5.1 Total fuel consumption in the Other Uses Sector[5].

FUEL TYPES			kTEP	%
LIQUID FOSSIL	SECONDARY FUELS	KEROSENE	683.24	16.79
		LPG	186.70	4.58
TOTAL LIQUID FOSSILS			869.94	
SOLID FOSIL	PRIMARY FUELS	COAL	7.43	0.18
TOTAL SOLID FOSILS			7.43	
GAS FOSIL	PRIMARY FUELS	NATURAL GAS (DRY)		
	SECONDARY FUELS	DISTRIBUTED GAS	45.90	1.13
TOTAL GASEOUS FOSSIL			45.90	
TOTAL FOSSILS			923.27	
BIOMASS	BIOMASS SOLID	WOOD	2761.50	67.89
		DUNG	259.50	6.38
		CHARCOAL	123.90	3.05
TOTAL BIOMASS			3144.90	
TOTAL			4068.17	100

Table I.2.5.2 Fuel consumption from the Residential/Commercial subsector.

I.2.5.1.2 Fuel consumption in the Mining Metallurgy subsector

Table I.2.5.3 shows the fuel consumption in the Mining Metallurgy subsector for 1990. The main fuels are residual oil accounting for 71.59% of a total of 379.65 kTOE, diesel 13.30% and Coke 7.07%.

FUEL TYPES			QUANTITY (KTOE)	%
Total Liquids Fossil	Secondary Fuels	Gasoline	11.36	2.99
		Jet Fuel	4.60	1.21
		Residual Oil	271.79	71.59
		LPG	2.10	0.55
		Lubricants	4.62	1.22
		Diesel Oil	50.50	13.30
Total Liquids			344.97	
Solid	Primary			
Secondary Fuels		Coke	26.84	7.07
Total Solid Fossil			34.69	
Total Fossils			379.65	100

Table I.2.5.3 Fuel consumption for the Mining Subsector

I.2.5.1.3 Fuel consumption in the Fishing Subsector

In 1990, the Fishing Subsector consumed 206 kTOE of fuel. (For more information refer to table I.2.5.4). In this sector Residual oil and diesel oil, account for 80.46% and 19.36% respectively, both were the most consumed fuels.

FUEL TYPES			QUANTITY (KTOE)	%
Liquid Fossil	Secondary Fuels	Gasoline	0.30	0.15
		Residual Oil	165.82	80.46
		Diesel Oil	39.90	19.36
		Lubricants *	0.07	0.03
Total	Liquid fossil		206.09	
TOTAL	Fossil		206.09	100

* Used like energy products.

Table I.2.5.4 Fuel Consumption in the fishing subsector

I.2.5.1.4 Fuel consumption in Public Services Subsector

Table I.2.5.5 shows the fuel consumption of the Public Services Subsector during 1990. The most used fuels were hydrocarbons accounting in total for 284.42 kTOE; diesel 42.20%, jet fuel 19.24% and gasoline 25.95%; the table also presents the lubricant consumption (non energy).

FUEL TYPES			CANTIDAD	%
LIQUID FOSSILS	SECONDARY FUELS	GASOLINE	73.80	25.95
		KEROSENE	5.46	1.92
		JET FUEL	55.28	19.44
		RESIDUAL	22.63	7.96
		LUBRICANTS	1.55	0.54
		DIESEL OIL	125.70	44.20
TOTAL LIQUIDS FOSSIL			284.42	
TOTAL FOSSILS			284.42	100.0

Table I.2.5.5 Fuel consumption in the Public Service subsector.

I.2.5.1.5 Fuel consumption in the Agricultural and Cattle-Agricultural Industry subsector

Table I.2.5.6 presents the fuel consumption of this sector. Taking into account the energy use of biomass, fuel consumption is 57.88% of a total of 212.22 kTOE followed by Residual oil (32%) and diesel oil (8.76%).

			AMOUNT	
Liquids Fossil	Secondary Fuels	Gasoline	2.60	1.23
		Kerosene	0.11	0.05
		Jet Fuel	0.09	0.04
		Residual	67.90	32.00
		Lubricants	0.07	0.03
		Diesel Oil	18.60	8.76
Total Liquid Fossils			89.31	
Biomass	Biomass Solid	Bagasse	122.84	57.88
Total Biomass			122.84	
TOTAL			212.22	100

Table I.2.5.6 Fuel consumption from agriculutre cattle/agricultural industry subsector.

I.2.5.2 EMISSION INVENTORY OF THE OTHER USES SECTOR

I.2.5.2.1 CO_2 emission inventory

Table I.2.5.7 presents CO_2 emissions Inventory according to each type of fuel for the Public Services Subsector. Table I.2.5.8 shows the emissions of the Fishing subsector.

FUEL CONSUMPTION AND CO_2 EMISSION IN THE PUBLIC SERVICE SUBSECTOR - 1990

SECONDARY TYPES		(KTOE)	Gg of CO_2
LIQUID FOSSILS	GASOLINE	73.80	211.99
	KEROSENE	5.48	16.26
	JET FUEL	55.78	163.83
	RESIDUAL	22.63	72.52
	LUBRICANTES	1.55	4.71
	DIESEL	125.70	385.90
TOTAL		[illegible]	[illegible]

Table I.2.5.7 Fuel consumption and CO_2 emission in the Public Service subsector

FUEL CONSUMPTION AND CO_2 EMISSION IN THE FISHING SUBSECTOR

FUEL TYPES		(KTOE)	Gg of CO_2
LIQUIDS FOSSILS	GASOLINE	0.30	0.86
	RESIDUAL	165.82	531.75
	LUBRICANTS	0.07	0.21
	DIESEL	39.90	122.49
TOTAL		206.09	[illegible]

Table I.2.5.8 CO2 emission and fuel consumption for the fishing subsector.

Table I.2.5.9 presents the emissions of the Agriculture and Cattle/Agricultural Industry subsector according to each type of fuel. Biomass consumption is the most important in this subsector. Table I.2.5.10 shows the emission of the Mining/Metallurgy subsector, the main activity in this subsector is the extraction and processing of minerals.

FUEL CONSUMPTION IN THE AGRICULTURE AND CATTLE/ AGRICULTURAL INDUSTRY - 1990

FUEL TYPES		(KTOE)	Gg of CO_2
LIQUID FOSSILS	GASOLINE	2.60	7.47
	KEROSENE	0.11	0.33
	JET FUEL	0.09	0.27
	RESIDUAL	67.91	217.77
	LUBRICANTS	0.07	0.21
	DIESEL	18.60	57.10
TOTAL LIQUID FOSSIL		89.38	283.15
BIOMASS	BAGASSE	122.84	496.19
TOTAL		212.22	779.34

Table I.2.5.9 Fuel consumption an CO_2 emission for the agriculture and cattle/agrc. industry subsector.

FUEL CONSUMPTION AND CO_2 EMISSION IN THE MINING SUBSECTOR

FUEL TYPES		(KTOE)	Gg of CO_2
LIQUID FOSSILS	GASOLINE	11.36	32.63
	JET FUEL	4.60	13.63
	RESIDUAL	271.79	871.56
	LPG	2.10	5.49
	LUBRICANTS	4.62	14.04
	DIESEL	50.50	155.04
TOTAL LIQUID FOSSILS		344.97	1092.40
SOLID FOSSILS	COAL	7.85	30.47
	COKE	26.84	119.12
TOTAL SOLID FOSILS		34.69	149.59
TOTAL		379.66	[illegible]

Table I.2.5.10 Fuel consumption and CO_2 emission in the minig subsector.

Table I.2.5.11 presents the emissions of the Residential/ Commercial subsector, it can be observed that biomass consumption is very important in this subsector. The emissions are mainly due to wood consumption to meet cooking needs.

FUEL TYPES		(KTOE)	Gg. of CO_2
LIQUID FOSSILS	KEROSENE	683.24	2035.26
	LPG	186.70	488.05
TOTAL LIQUIDS FOSSILS		869.94	2523.30
SOLID FOSSILS	COAL	7.43	28.84
TOTAL SOLID FOSSILS		7.43	28.84
GAS	DISTRIBUTED GAS	45.90	106.57
TOTAL GASEOUS FOSSILS		45.90	106.57
TOTAL FOSSILS		923.27	2658.71
BIOMASS	WOOD	2761.60	11027.81
	DUNG .	259.50	1012.47
	CARBON VEGETAL	123.90	600.47
TOTAL BIOMASS		3144.90	12540.76
TOTAL		4068.17	15189.46

Table I.2.5.11 Fuel consumption and CO_2 emission for the residential/commercial subsector.

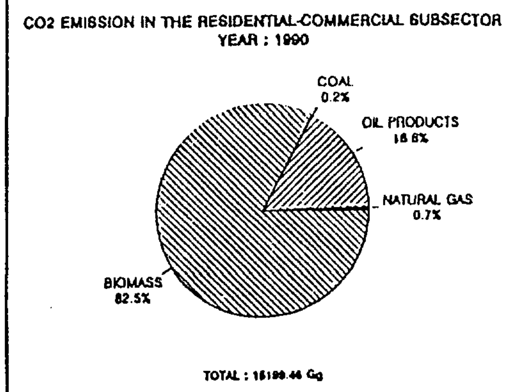

Fig. I.2.5.1 Percentage composition of the CO_2 emission in the Residential/Commercial subsector.

Table I.2.5.12 shows the total emissions according to fuel type in the Other Uses sector. The percentage rate is shown in figure I.2.5.2. We can observe that the residential sector presents an important biomass consumption due to the fact that Rural population only use wood to meet cooking needs.

FUELS CONSUMPTION AND CO_2 EMISSION IN THE OTHER USES SECTOR - 1990

FUEL TYPES		(KTOE)	Gg of CO_2
LIQUID FOSSIL	GASOLINE	88.08	262.95
	KEROSENE	688.81	2051.84
	JET FUEL	59.97	177.73
	RESIDUAL	528.15	1693.62
	LPG	188.80	493.54
	LUBRICANTES	8.31	19.17
	DIESEL OIL	234.70	720.53
TOTAL LIQUID FOSSIL		1794.80	5409.38
SOLID FOSSILS	COAL	15.28	59.31
	COKE	26.84	119.12
TOTAL SOLID FOSSILS		42.12	178.43
GAS FOSSILS	DISTRIBUTED GAS	45.90	106.67
TOTAL GAS FOSSILS		45.90	106.67
SOLID BIOMASS	WOOD	2761.60	11027.85
	DUNG	259.50	1012.43
	BAGASSE	122.84	496.19
	COAL	123.90	500.47
TOTAL BIOMASS		3267.74	13036.94
TOTAL		5150.56	18731.32

Table I.2.5.12 Fuel consumption and CO_2 emission for the other uses sector.

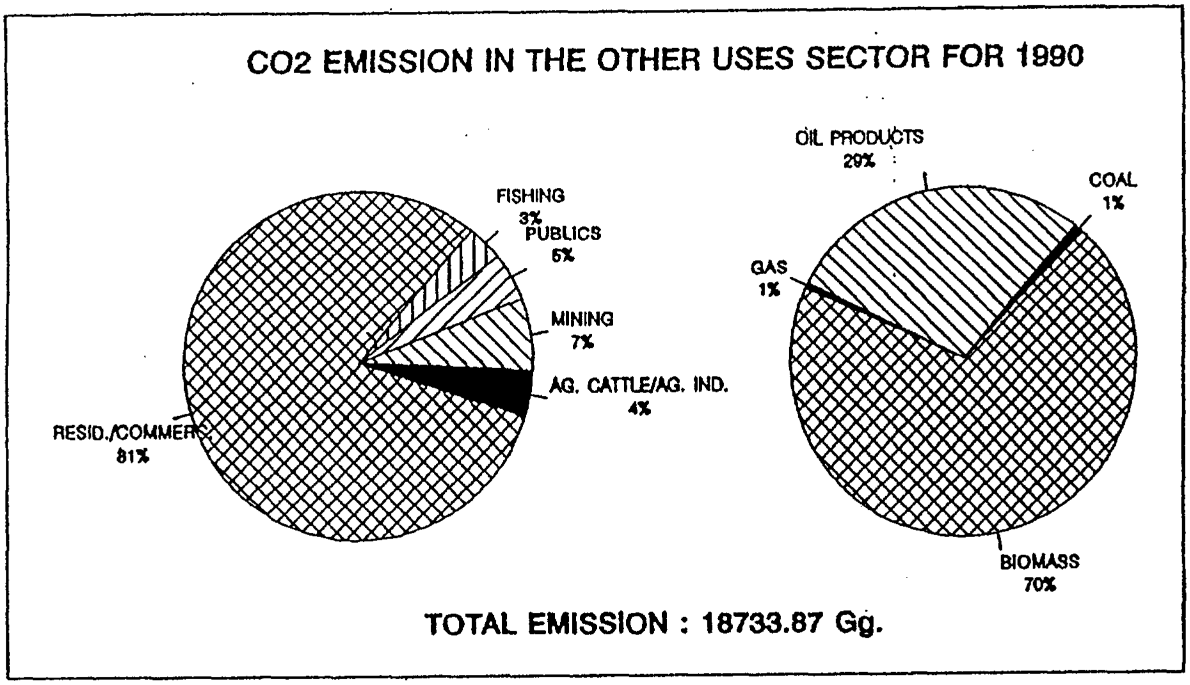

Fig. I.2.5.2 Percentage composition of the CO2 emission in the Other Uses Sector.

I.2.5.2.2 CH_4 and N_2O emissions inventory due to biomass consumption

Table I.2.5.13 presents the results of CH_4 and N_2O emissions estimates resulting from biomass fuel consumption for the subsectors that belong to the Other Uses sector Since Residential/Commercial and Agricultural and Cattle/Agricultural Industry Subsectors are the only biomass consumers, they are also the only emitters. The IPCC methodology has been used to determine these estimates [1,2,3].

SECTORS	CH_4 EMISSION Gg		N_2O EMISSION Gg	
	QUANTITY	%	QUANTITY	%
RESIDENTIAL COMMERCIAL	73.04	95.80	0.47	97.9
AGRIC. AND CATTLE AGRIC. INDUSTRY	3.23	4.20	0.01	2.1
TOTAL	76.32	100	0.48	100

Table I.2.5.13 Methane and nitrous oxide emissions in the Other Uses Sector.

I.2.5.3 ANALYSIS OF THE RESULTS

During 1990, the CO_2 national inventory from the sector other uses was 5696.38 Gg (without taking into account biomass consumption). The Residential commercial Subsector was the major emitter accounting 46.77%, following by the Mining/ Metallurgy Subsector with 21.37%.

Considering biomass consumption, the total emission was 1871.32 Gg. This emission is due to the high consumption of wood of the Rural population which uses this resource to meet cooking needs.

The emission from the Residential/ Commercial Subsector accounts for 81% (15199.46 Gg) of the total emission of the Other Uses sector. It is necessary to apply proper governmental policies aimed at the reduction of GHG emissions in this sector.

Therefore, the major methane emission in the Other Uses sector is due to emission from the Residential/ Commercial subsector accounting this for 73.04 of the total and 98% of the N_2O emission.

II NON ENERGY SECTOR

II.1 GENERAL RESULTS

In the non energy sector, the activities that contributes with GHGś emissions are: industrial processes, Agricultural and Cattle activities, land use change and Wastes.

The most significant contributor to CO_2 emissions are the activities related to land use change such as forest clearing, conversion of grasslands into cultivated land, abandoned cultivated land and the exploitation of forest which constitutes sinks of CO_2. These activities release into the atmosphere a total of 83132.41 Gg of CO_2.

CH_4 is emitted mainly due to land use change (680.92Gg) and Agropecuarian activities (440.786 Gg). Wastes are also great emitters of CH4 (130.260.

N_2O is emitted in minor amounts in respect to other gases mentioned above. These emission are from Agricultural and Cattle activities (3.15 Gg) and land use change (3.03 Gg).

Table II.1.1 presents a summary of the emissions from the different activities.

SOURCES	EMISSIONS (Gg)		
	CO_2	CH_4	N_2O
Industrial Process	1089.22	---	---
Agriculture and cattle	---	~~721.81~~	3.15
Land use change and silviculture	83132.41	440.78	3.03
Wastes	---	130.26	---
TOTAL	84221.63	~~1292.85~~	6.18

680.92

Table II.1.1 Total greenhouse gases for the non energy for 1990.

1251.96

II.2 EMISSIONS FROM NON ENERGY SECTOR

The results obtained from the National inventory of the non energy Sector, according to categories or source of emissions are presented here:

II.2.1 Industrial processes area

Emissions due to industrial Processes are products from the different production processes; the emissions from energy combustion used during production processes (1) have not taken into account here, since they appear as part of the energy sector.

Cement production are the major CO_2 emitter of the industrial processes. In 1990, cement production was 2185 kTONNES (16). This production was generated by the five cement producer companies of the country which emitted 1089.22 Gg of CO_2.

CO_2 emission is produced during clinker manufacturing (product from which cement is made by calcination process (in cement furnaces)(1) at high temperatures.

II.2.2 AGRICULTURAL AND CATTLE AREA

The GHG gases emitted due to the different Agricultural and cattle activities are: CH_4 and N_2O.

In Peru, the most important gas emitted due to Agricultural and Cattle activities is CH_4. These activities emit 680.936 Gg of methane.

The emissions from the aboved mentionesd activitieś are emitted due to livestock enteric fermentation and animal manure which account for 366.45Gg and 16.29 Gg of CH_4 respectively.

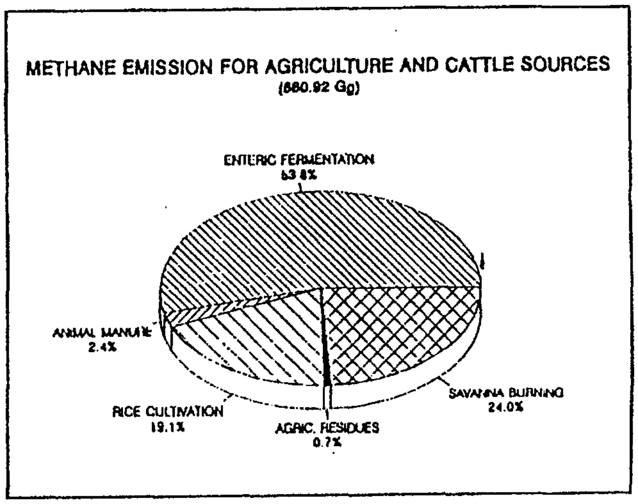

Fig. II.2.2.1 Total methane emission.

Savanna burning, rice cultivation and burning of agricultural wastes are also methane emitters releasing into the atmosphere 163.57 Gg, 129.80 Gg and 4.81 Gg respectively (Figure II.2.2.1). Table C4 and Appendix C (2) presents the estimates in detail.

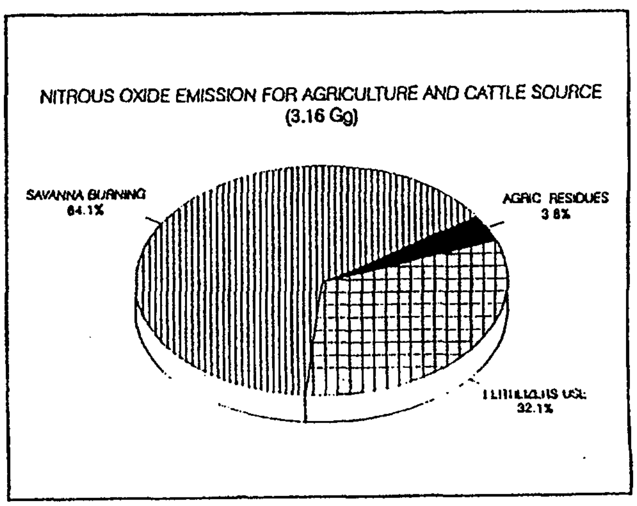

Fig. II.2.2.2 Total nitrous oxide emission.

The Agricultural and cattle activities that generates N_2O emissions are Savanna burning, the use of nitrogen fertilizers and the burning of agricultural wastes which emits into the atmosphere 2.02 Gg, 101 Gg and 0.12 of N_2O respectively. As a result of this, they account for 64.1%, 32.1% and 3.85% of the N_2O emissions in this area (figure II.2.2.2).

II.2.2.1 Animal enteric fermentation

In Peru, emissions from enteric fermentation are 366.45 Gg accounting for 50.8% of the total emissions from Agriculture and Catlle activities. Methane is produced during animal digestion. Emissions due to domestic livestock enteric fermentation and animal manure for 1990, have been estimated using IPCC methodology.

Figure II.2.2.2 presents data about animal population in 1989,1990,1991 (18, 19, 200. The rate has been obtained multiplying it by its corresponding emission factor of each category [2].

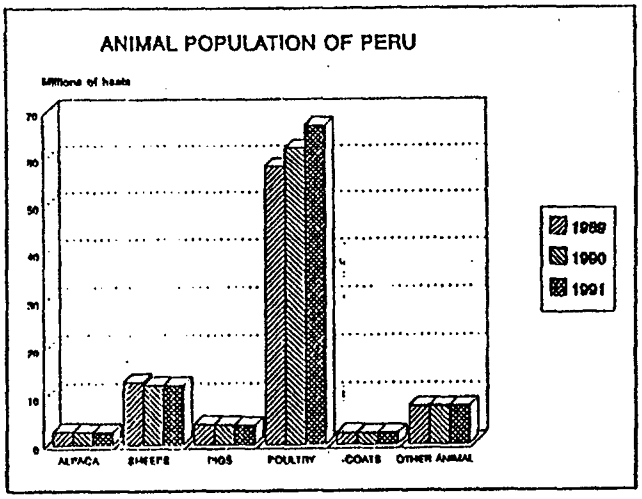

Fig. II.2.2.1.1 Population of the main domestic animal.

II.2.2.2 Animal Manure Management

The emissions estimates due to Animal manure management are 16.29 Gg accounting these for 2.3% of the methane emissions from the Agricultural and Cattle activities. When animal manure decomposes in an anaerobic environment, decomposition of the organic material in the manure, produces methane. This is due to the fact that a great number of animals live in small areas where their manure is storaged [1].

We have used data taken from the Ministry of Agriculture, Universities, INEI, INIAA, thesis from FAO, IVITA and other research studies, in order to obtain the estimates. Because of the difference existing among this data , we have carried out an analysis to apply the information supplied by the Ministry of Agriculture. It is important to consider that this data are statistical projections from the Census of 1972. We have taken as a reference the number of animals estimated by FAO 1990 [20], due to the lack of information about populations of horses, goats and donkies for the period between 1989-1991.

As in enteric fermentation, the emissions estimates was made using the factors emissions of the manure management for each category [2].

II.2.3 Rice cultivation

In Peru, emissions from rice cultivation generates 129.80 Gg of CH4 accounting approximately for 18% of the emissions from the Agricultural and Cattlelarea. Emissions released are due to methane production from anaerobic descomposition of soil organic matter in flooded rice. Methane is released into the atmosphere through air/water via diffusion, bubbling through floodwaters and transport through rice plants [1].

Methane emission from rice cultivation were derived using the IPCC methodology (2). this methodology is based on the flooded rice cultivation area and the temperature rate of the growing season. San Martin has the largest harvested area with an average yield of 4.1 MT/ha, accounting for 14.3% of the total rice harvested area. Eventhough, La Liberated is the department that has the major rice production with an average yield of 6.3 TM/ha.

Arequipa also shows the highest production yield with a high rate of 10.5 MT/ha (Figure II.2.2.3.1).

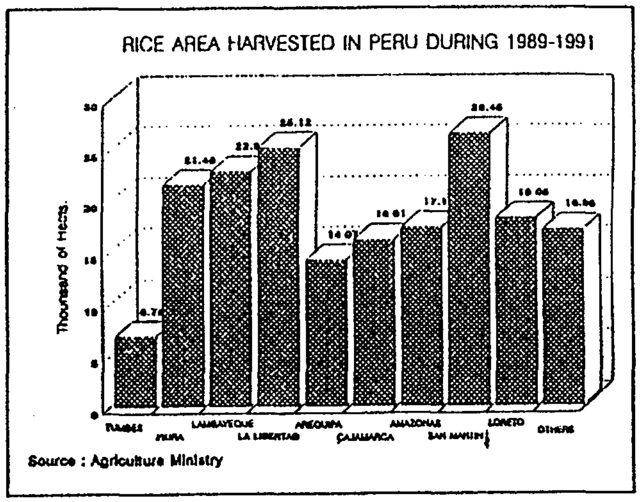

Fig. II.2.2.3.1 Harvested rice area by departments.

Rice harvest season depends on the rice fields. In the following section, we have made an explanation about such seasons for the great rice producers [23]

Cultivated Region: Coast

Tumbes y Piura	: The whole year
Lambayeque	: Nov.- Dec.
Pacasmayo	: Oct.- Nov.- Dec.
Ancash and Arequipa	: Oct.- Nov.

Cultivated Region: High Jungle

Bagua, jaen, Tarapoto, Rioja:	The whole year
Due to hood	: March-Apr.
Due to Secano	: Oct.-Nov

Cultivated region : Low Jungle

Yurimaguas and Iquitos	: The whole year
Due to Hood	: March- Apr. or Jul.- Aug.
Due to Barrial playa	: may- Jun.

In Peru , we have three different irrigation systems [23]:

a. Secano System which depends on the rain.

b. Flooded system or gravity irrigation which allows a better control of the cultivation conditions, because it mentions rice pozos with a higher water lay.

c. Playa barrial system or intermittent flood, consists in use of the fields left by the rivers of the jungle when its flow decrease.

The prevailing irrigation system in Peru is the flooded system. Eventhough, in some places the secano and barrial systems are used but as a complement for the irrigation system.

The rice cultivation period in our country is from 30 to 160 days, we can consider 150 days as an average [23].

II.2.2.4 Use of Nitrous Fertilizers

In Peru, nitrous oxide emissions (N_2O) due to the use of nitrous fertilizers are 1.01 Gg accounting for 32.1% of the total N_2O emissions of the Agricultural and Cattle area.

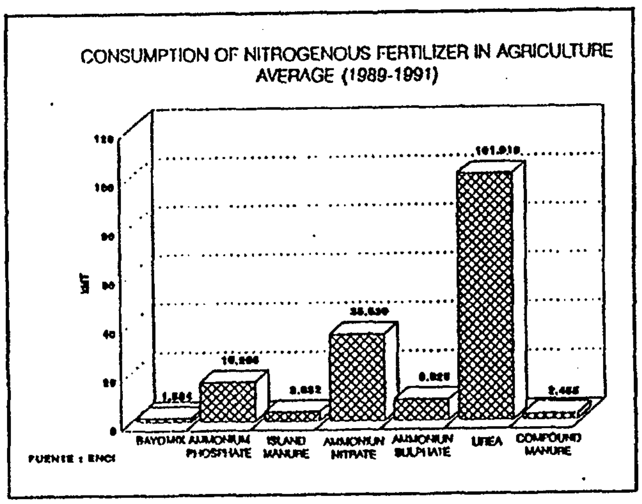

Fig. II.2.2.4.1 Nitrogenous fertilizer consumption in the agriculture.

The methodology applied is a simplified method of the IPCC (Reference manual Volume III) which recommends that 1% of the nitrogen applied as fertilizer is released into the atmosphere. The estimates are also based on the fertilizers consumption from agricultural practices during three years (89-91). 1990 shows the major estimates [1]

In this Inventory, we have considered seven types of nitrous based fertilizers which are used in Peru (24,25). To estimate the amount of fertilizers used, we have taken into account their sold amount, assuming in this way that, this sold quantity is equivalent to the one consumed for the period beetwen 1989-1991(24).

The most nitrous fertilizer used in agricultural practices is urea accounting for 60% of the total fertilizers used in Peru. The fertilizer used in the lowest quantities is the bayomix, accounting for only 0.94% (see Figure II.2.2.4.1).

In Peru, the estimates about use and consumption of fertilizers are uncertain, this is because of the lack of data about their employment after their purchase (for this study, we have assumed that they are mainly employed in agricultural practices).

Nitrous fertilizers are used in all types of agricultural practices, if not it is because of economical restrictions [25].

II.2.2.5 Field Burning of agricultural Wastes

Emissions from field burning of Agricultural wastes are mainly CH4 and N_2O. They emit into the atmosphere 4.81 Gg and 0.12 Gg respectively. Table C5 and Appendix C (2) present in detail the emissions estimates.

This emission source is a common one in Peru. In our country, the burning of agricultural wastes is practiced in a minor scale, this is due to the fact that each kind of waste has a useful aim for the farmers. Farmers burn wastes only when they are unuseful for them. As a result of this, the emissions from this resource are nearly insignificant.

The agricultural wastes burned result from wood, sugar cane, rice, asparagus, potatoes, corn, wheat, barley and beans. Figure II.2.2.5.1 shows the fraction of field burned according to the national agricultural practices. For the present study, we have used the statistic about agricultural production of each field of cultivation for the period between 1989-1991, taking also into account the annual average of the three years of analysis [21].

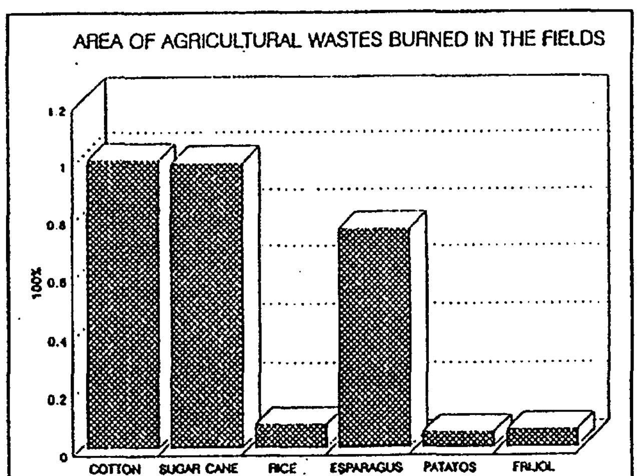

Fig. II.2.2.5.1 Waste area burned due to agricultural aims.

Agricultural wastes are useful for other activities such as animal food, incorporation of these wastes into the soil in order to improve its quality (using them as construction materials in the building of houses).

Nevertheless, there is a particular time to burn wastes, specially when we want to avoid the damaging effect of the freezing (abrupt temperature decrease that causes damage to the crops).

Finally we can assert that, in Peru crop wastes are burned only when:
They can not be use as animal food.

- Can not be used as fertilizer.
- They have phytosanitarie problems
- They do not have any local usefulness

La Universidad Nacional Agraria La Molina (National Agricultural University of La Molina (UNAL)- institution related to the study and research of the national agriculture has performed studies about the dry matter contents of wood, asparagus and sugar cane wastes as well as ratio estimates of residuals/cultivate for wood, sparagus, beans. These have been quoted in the references [26, 27, 28]. See tables II.2.2.5.1 and II.2.2.5.2.

CROP	DRY MATTER FRACTION	REFERENCESS
COTTON	0.6	Gamarra, L. (1967) Algodonero, Pág.28, Fac. de Agronomía, UNALM-Perú
ASPARAGUS	0.7	Suárez, M.(1993) Tesis sobre Espárrago UNALM -Perú.
SUGAR CANE	0.4	Análisis Científicos UNALM - Perú.
OTHERS CROPS		IPCC/OECD. GHG's Inventory Workbook Vol.2.Table 4.12-Pág.4.28

Table II.2.2.5.1 Dry Matter contents in the residual/cultivation.

CROP	WASTE/CROP RATIO	REFERENCESS
COTTON	7.53	IPCC/OECD. GHG's Inventory Workbook Vol.2.Table 4.12-Pág.4.28
ASPARAGUS	2.8	
BEANS	1.5	
OTHER CROPS		

Table II.2.2.5.2 Ratio of Wate/Crop according to the type of crop

II.2.2.6 Savanna Burning

GHG emissions due to savannas burning (tropical and subtropical formations with pasture areas occasionally obstructed by trees and bushes) are mainly CH_4 with 163.57 Gg and N2) with 2.02 Gg. In respect to CO_2 emissions, we have not considered them as a net emission, since the burned biomass has been replaced in the following year [3].

Savanna burning is accomplished with the aim to control vegetation growth, avoid insects and undergrew pasture, promote nutrient cycle, regrowth new pasture and for the shepherd of animals [1].

The estimates have been made according to the data of the Forest Resource Assessment 1990 (FAO Document 12)(29) which is similar to the one about savannas burning:

Deserted area (cold - hot)	22,896,000 Ha
Very dry area	7,127,000 Ha
Dry area	388,000 Ha

Since we do not have any information about this aspect, we have defined savanna as the addition of the foregoing three areas,. The savanna area considered in this study is 30,411 Kha [29].

The burned area is the result of a multiplication of the savanna area with the defecting value from the statistics of regional Savanna for tropical America (50%/ year).

The methodology used in this study is the one recommended by the IPCC Worksheet about Greenhouse Gases Inventory for Savanna Burning [2].

II.2.3 LAND USE CHANGE AND FORESTRY

Total emissions from this sector are mainly CO_2 emissions with 83132.4 accounting this 98.7% of the CO_2 emission of the Non Energy Sector for 1990. The CO_2 emission sources are mainly forest clearing and reversion of clearing lands to cultivated land (section II.2.3.2), which release into the atmosphere 130112.69 Gg and 3062.40 Gg respectively.

CO_2 absorption due to the exploitation/ forest management and abandoned cultivated lands are 49714 Gg and 327.81 Gg of CO_2 respectively. Figure II.2.3.1 presents the CO_2 emissions and absorption for each source. Clearing of forest, abandoned cultivated land, conversion of pastures into cultivated lands and arrangement of lands are also CO_2 absorption sources [2].

II.2.3.1. Clearing of Trees

Emissions from forest clearing are the major CO_2 source in the Non Energy Sector with 130112.69 Gg of CO_2. Other gases from forest burning such as CH_4 and N_2O emit to the atmosphere 440.78 Gg and 3.03 Gg respectively.

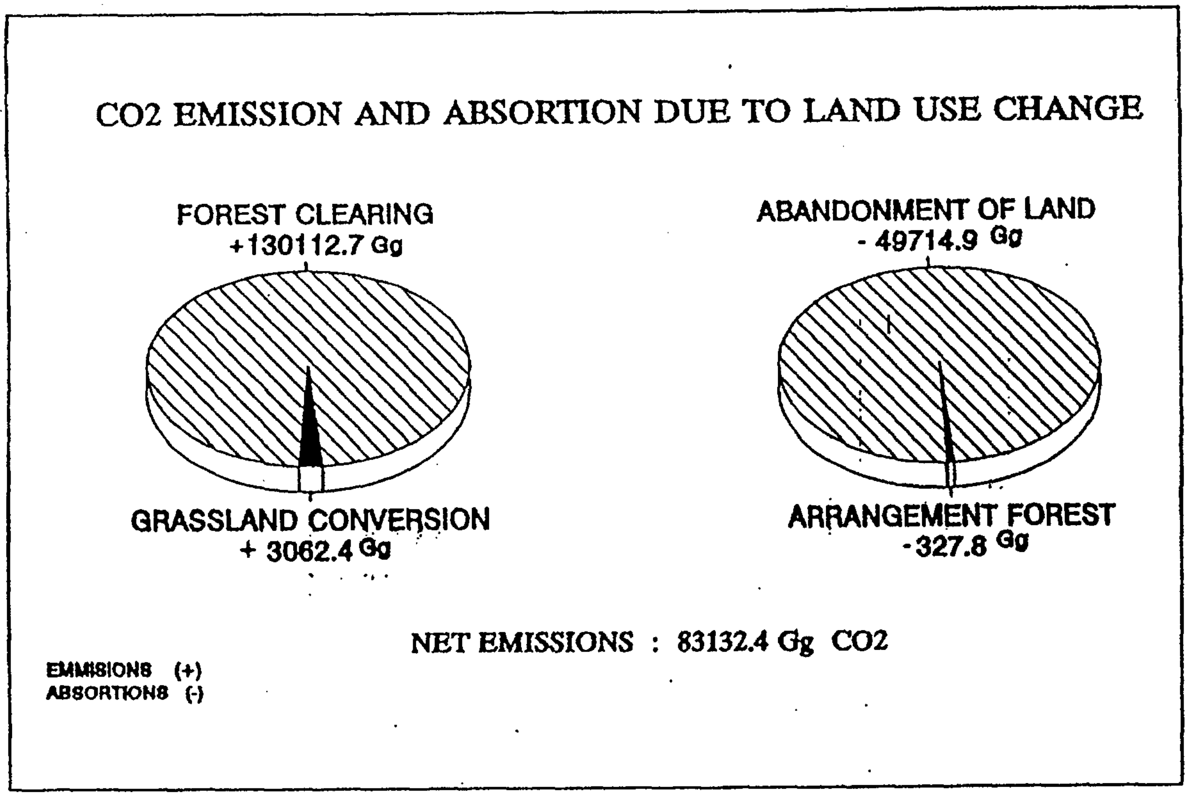

Fig. II.2.3.1. CO_2 total emissions from forest.

These emissions are produced from burning and decomposition of biomass, cut of trees and soil alteration due to tillage practices specially in the cases in which these activities are related to the conversion of forest (through clearing) into permanent cultivated land [1].

Data have been obtained in a 75% according to the interpretation of satellite pictures and its own tabulation. According to the results obtained from the clearing area of 1985 and 1990, we can observe an increase among this two periods, a clearing rate, a balance of the original forest of 1990 and some estimates from statistics reports [16, 30, 31, 32, 33, 34, 36].

The estimates about the clearing area rate was determined by using the difference existing between values and years (1985-1990) resulting from the interpretation of satellite picture in a 75%. We have obtained the following results:

Deforestation annual rate for 1990 = 270,000 Ha.

In respect to the current use of lands, this was interpreted according to the satellite pictures, considering in this way total estimates such as:
Total deforestation in the Jungle: 7250,000 Has, from which only 20% (1450,000 Has) are in agricultural crops and pastures; 80% (5'800,000 are abandoned in the secondary forest (32,35,37).

The annual forest clearing area (10 years) was obtained from the article wrote by Eng. Jose Dance 1979 (Peruvian Forestry Magazine "Deforestation Trends and Agriculture and Cattle aims in the Peruvian Jungle" (37)). According to this article, 5122,000 Has of land have been cleared since 1979, getting in the last 10 years the following deforestation average in the last 10 years.

Deforestation rate : 193, 454 Has/ year.

The annual mean of clearing forest (an average of 25 years) was obtained using a graphical estimate, getting in this way a result of 130,000 Has/year [35].

II.2.3.2 Conversion of natural grasslands into Cultivated lands

CO_2 Emission from this category (3062.40 Gg) are from the conversion of grasslands into cultivated lands due to the soil alteration and the oxidation from soil carbon. Peru has a land surface of 128000,000 Ha, from which 27604,00 are destinated to natural grasslands (24558,00 Ha according to UNA-1978).

For 1989, 3730,000 Has. have been estimated to be use for agricultural crops. We have considered the following assumptions in order to estimate the net surface of converted natural grasslands into cultivated crops :

1.- The increase of the cultivated lands in the last 25 years is due to forest clearing and the use of natural grasslands for agricultural practices.
2.- Deforestation is caused mainly due to the migratory agriculture and only 20% of these lands are used as cultivated lands [37].
3.- The agricultural potential attitude for the clear and permanent crops is the resource that presents the major scarcity, we can only used 6% of the total surface, being the limiting factors the climate and soil.

The net area of natural grasslands converted into cultivated areas in the last 25 years is 696,000 Ha.

II.2.3.3 Abandoned Cultivated Lands

In this category CO_2 emissions and absorption (49714.87) are due to abandoned cultivated lands such as crops and pastures. From 2600,000 Has. of land, the total abandoned area during the last 20 years is 2080,000 Has.

These results has been obtained using estimated data; the total abandoned area during the last 20 years is 3720,00 Has. [31, 35].

II.2.3.4 Exploited and Managed Forests

CO_2 emissions and absorption (327.816 Gg) in this category are due to the decomposition of exploited products such as paper, wood for building etc., and from biomass decomposition resulting from exploitation processes. These emissions are partially disminished by biomass growth. The plantation of trees have been also considered in this category [33, 38].

According to statistical analysis about Forest management, 263,00 Has. of land have been reforested till 1990 considering all kind of species. For this reason, the annual growth rate has been estimated from the mixture of all the hard wood which present a fast growing (13.5 ms/Ha) [30, 38].

Commercial wood has been estimated to be 122.86 Km^2 from the production of 1990 (according to the yearly report of sawn wood). Eucalipt, ishpingo and cedar, which are converted into biomass through the commercial harvest, present a value of 307.15 Gg ms [39].

Traditional wood consumption have been estimated based on the national statistics (6491,000 m^3) [16].

II.2.4 RESIDUE AREA

The Greenhouse gas that comes from residues is Methane. Its estimated emissions for 1990 are 130.26 Gg. methane emission sources constitute landfills accounting 28.93 Gg, waste water 4.43 Gg and Industrial waste water 26.78 Gg. All of these, represent 22.2%, 53.8%, 3.4% and 20.6% of the total estimated emissions for this area. (See Figure II.2.4.1).

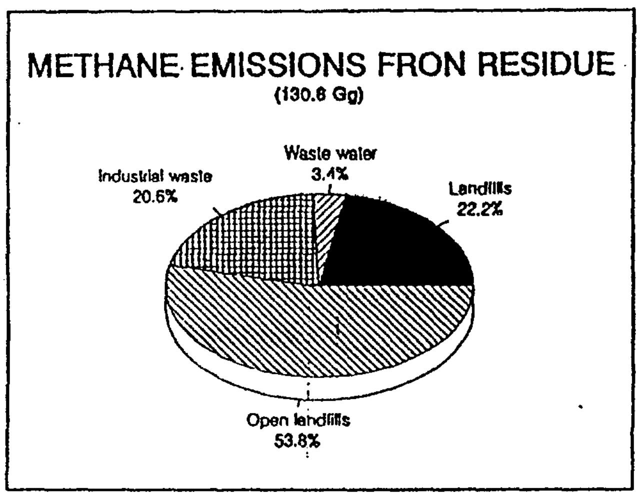

Fig. II.2.4.1 Total methane emissions from wastes.

II.2.4.1 Landfills

The emissions from this source release into the atmosphere 28.93 Gg of methane. In the case of Peru, only 3 landfills were reported for 1990, 2 in Lima and 1 in Trujillo. These are insufficient to cover the population needs due to their capacity or distance far from the cities. This aspect causes the proliferation of open landfills [40].

Table II.2.4.1.1 presents the arrangement of municipal solid wastes (DSM) generated and placed in landfills and open dumping with their corresponding methane emissions into the atmosphere.

DSM DISPOSITION	DSM Generated (Gg)	Percentage of Generation DSM	DSM Descomposition (Gg)	CH_4 emission (Gg)
Landfills				
2 in Lima	958.37	27.1 %	335.43	25.83
1 in Trujillo	95.96	2.7 %	40.30	3.10
Open landfills	2482.84	70.2 %	1821.40	70.12
TOTAL	3537.17	100 %	2197.13	99.05

Table II.2.4.1.1 Disposition of solid municipal wates (DSM) [40,41].

This data was taken from rstudies carried out by public and international institutions. These studies are mainly based on the generation per capita of municipal solid residue as well as on their amount produced per day, considering the urban and rural population. The employed figures taken are preliminary numbers from the last national census of 1993 (42). These numbers have been estimated for 1990 considering the growth of population of about 2%.

According to a study accomplished in 19 cities (CEPIS/OPS/ Sectorial study about solid residues of Peru 1990), the average urban generation rate in our country is 0.54 Kg/Ha/ day. The study carried out by DIGESA (RESCADEC) have been also considered to estimate the generation rate in the remaining cities [40].

According to the National census of 1993, Lima region which cover Lima and Callao had a population of 7984500 inhabitants and a urban Population of 4954105 inhabitants who generates a total of 958370 Tm/year of solid wastes from which, approximately 35.5% is placed on landfills [41].

Trujillo, capital of the department of La Libertad, has a solid residue generation of 0.32 Kg/hab/day, placing 109/Tm/day in their landfills. This represent 42% of the total solid residue generated in 1990 [40].It is also important to consider that landfills of this city have an special cell in which wastes from hospitals are treated due to their pathologic characteristics. These cells operates since 1986 and have an useful period of 30 years [40].

In the department of Lima, which has a solid residue generation of 0.53 Kg/hab/day [41], only 35% of the total is placed in landfills, this is due to the extensive population growth resulting from the population migration to the cities where the problem of recolection and disposal of solid residues is most severe.

II.2.4.2 Open Dumpings

Since the use of Open dumping is a very common practice as well as an important generation source in Peru, the emissions from them are also included in this inventory.

According to the data supplied by the Empresa Nacional de Limpieza de Lima Metropolitana (ESMML) Municipal Cleaning Companiy Of Lima[41], Lima has 15 open dumpings. 65% of the total solid residues of Lima is placed on open dumpings.

However, they do not have any hygienic control and are located in different parts of the city. Due to the high cost of transportation of these solid wastes into landfills located far from the cities, these open dumpings have become sources of pollution. Sometimes solid residues are burned in open dumpings but also, the placement is accomplished in mounds located near rivers in such a way that, the river flow carry them away.

Part of the organic residues of the open dumpings are directly eaten by pigs. These pigs are breeded under unhygienic conditions being dangerous for consumers health.

As recommended by the GHGs Reference Manual [3], only 40% of the methane emissions was considered for the estimates of open dumpings.

The *solid residue fraction - placed on open dumpings -* for Lima and Trujillo is 0.65 and 0.58 respectively. This is the difference between the total wastes generated and the its final placement on open dumping [40, 41].

II.2.4.3 Domestic Waste water

Emissions from this source release into the atmosphere 4.43 Gg of methane accounting for 1990, 3.4% of the emissions from the Residue area. Methane emissions have been estimated considering a total population of 13805120 habitants as urban population (1990) which, according to the National Census of 1993 [42], accounts 65.33% of the total Peruvian population.

Wastes from urban areas are placed anaerobically in sewage systems. In Lima the sewage system service is estimated to be 95% of the total drink water service (6527 Km in 1990). These estimates do not include those industries which have their own main sewage channels. It has been also estimated that, from the water used by consumers, 80% goes to the main sewage channels [43].

Table II.2.4.31 presents information about useful capacity of the sewage channels as well as the annual average of water unloaded into waste water for Lima in 1990.

COLLECTOR	USEFUL CAPACITY (m^3/seg)	AVERAGE (m^3/seg)	DISCHARGE
Surco	10.77	5.36	
TOTAL	19.11	10.43	SEA
Colector N°6	3.50	1.44	
Condevilla	2.80	0.40	
Zarumilla	0.32	0.18	RIVER
TOTAL	6.62	2.02	
TOTAL	25.73	12.45	

Source : SEDAPAL, 1991

Table II.2.4.3.1 Useful capacity average of collectors and mean discharge of waste water (Lima Metropolitana).

Nowadays waste water from Lima is unloaded into sea and rivers. This unloading is causing beach pollution, specially during summer months (January, February and march), affecting in this way the health of people who visit them.

In other regions the sewage system is unefficient, it only covers 17.5% of the total.75% of the human excrement is disposed in open areas, this according to a study carried out by the Ministry of Human Health/ DIGESA-RESDDEC project [40]

Latrines are used in 8% as a mean of elimination. There are cities such as Chumbivilca and Espinar (Cuzco) in which the human excrement is disposed in open areas because of the lack of any sewage system (40). This aspect is a common one specially in Rural areas which accounts for 37% of the population, this estimates is based on the last National census 1993.

The creation of urban zones which do not have water and waste water streams services is the consequence of the excesive growth of population due to the people migration from the highlands to Lima and other coastal cities. These inhabitants use latrines as a mean for excrement disposal.

Lima has the major urban population accounting 37.8% of the total peruvian urban population, that is to say that, the population of Lima generates the major organic load (DBO) from domestic waste water streams accounting for 35.8% from a total of 201.428 Gg of DBO

II.2.4.4 Industrial waste water

Emissions from this source release into the atmosphere 26.78 Gg of methane. This represents approximately 20.6% of the methane emissions in the Residues area for 1990.
We have selected the key industrial activities of the country based mainly on the industrial waste water generated in industrial activities or processes.

The main industries that generate the major volume of waste water are: tannery, Textil industry, food industry (beer included) , and paper industry (appendix C, table C 15).

Industrial waste water are also employed in agricultural practices as an irrigation system, but before these waste water must to be treated and fulfill the regulations of water Pouring (General Law of water) which is not fulfilled in Peru. This irrigation system has become a pollution source, because food consumed by people is cultivated in crops irrigated with waste water, afecting in this manner the human health.

In Peru, many industrial waster water are poured into collectors without any type of treatment and then they are unloaded into rivers or sea, forming in this way putrefied mud banks which produce marine ecosystem alteration, suffocates flora and fauna and destroys the aquatic life. The IPCC methodologie [2], have been used to estimate methane emissions, national parameter such as DBO, and information sources about the water consumption by each type of industry [43,44,45,46,47,48 and 49] have been also used.

II.3 CONCLUSIONS AND DISCUSSIONS

From the general results obtained in the final GHG inventory of the Non Energy Sector for 1990, we can assert that the Greenhouse gas which present the major emission is CO_2 accounting for 84221.63 Gg of the total GHG emissions, followed by CH_4 wtih 1292.85 Gg and N_2O with 6.8 Gg. The total GHG emissions is 85479.77 Gg.

The 98.7% of the total CO_2 emission are due to land use change and Forestry caused by the clearing of forest and the remaining 1.3% is due to cement production in industrial process.

The Agriculture and Cattle activity is the major emitter source of CH_4 accounting for 54% of the total emission of such gas. This is mainly due to animal breeding, savanna burning and rice cultivation. 35% of the total CH_4 emissions are from Land use activities due to burning of forest. In the Residue area, CH_4 sources are landfills,open dumpings, domestic and industrial waste water streams. They represent 10.4% of the total emissions.

10.1

N_2O is the minor gas emitted and accounts only for 6.18 Gg. The methane sources are: Agriculture and cattle activity 51%, fertilizer use, burning of agricultural residues and savanna burning. Land change use due to forest burning account 49% of the methane emissions.

The sources that generate No_x emissions are: Agriculture and cattle activity and Forestry, both make a total of: 148.90 Gg de No_x. The Agriculture and Cattle activity accounts for 52% of the total emissions due to residues and savanna burning; Forestry accounts for 48% of the emissions due to Forest burning.

Finally, CO is generated from the following areas: Forestry, Agricultural Industy and Cattle activity and Industrial processes. They emitt a total of 10849.18 Gg of CO. The major CO emitter source is the Burning of Forestry accounting for 59.3% of the total emissions, followed by the Agroindustrial and Cattle activity through agricultural residues and savanna burning, which account for 40.5%. Industrial processes area accounts 0.2% of the total CO emissions due to iron production.

In conclusion, the greater non energy source is the land use change and Forestry, which due to forest clearing and pastures conversion, generate and emit great quantities of CO_2 into the atmosphere. These emissions are absorbed due to the abandoned cultivated lands and forest management.

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APPENDIXES

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APPENDIX A

A.1 COMPARISON OF THE RESULTS OF THE CO_2 EMISSION INVENTORY ACCORDING TO THE BOTTOM-UP AND TOP-DOWN OUTLINES

The IPCC recommended methodology presents two outlines referred to as : BOTTOM- UP and TOP- DOWN. The top-down outline includes production (extraction), importation, stock change and exportation of energy products. The bottom-up outline includes fuel consumption according to the different end-use sectors such as: Industrial, Mining, Residential and other activities.

TOP-DOWN METHOD

As suggested by the IPCC, an explanation about the apparent consumption has been introduced in this study applied to the top down method. This is due to the fact that in the Peruvian Energy Balance (table I.1.1) does not appear such consumption in a direct form.

a) The IPCC methodology uses the following formula to determine the apparent consumption of primary and secondary products:

$$\text{Apparent Consumption} = \text{Production} + \text{Importation} + \text{Exportation} + \text{Stock change}$$

Production refers to the production of primary energy products such as oil, natural gas, coal etc. It does not include gasoline and diesel which are calssified as secondary products because they come from a transformation process.

Importation, Exportation and Stock Change include all the primary and secondary products

b) The following formula has been used in the Peruvian Energy Balance to determine the apparent consumption:

Apparent Consumption	=	**Production + Importation + Adjustments + Non Energy + Unuseful energy + Exportation + Stock change.**

The term reffered to as "Adjustments"appears in the column II of the National Energy balance (Table I.1.1.1). The aim of this parameter is to achieve a balance between the reported data about production, importation etc. with the one reported by the final energy consumers sucha as industrial and Transportation sectors.

Therefore the term "Unuseful Energy"(row 6 of the National Energy Balance) has the aim to quantify the amount of natural gas used in the injections of reservoires from oil tanks, losts in the transporattion to gas plants etc.

The row referred to as "Non Energy"is also included in the National Energy Balance. It includes bagasse. If we consider the production of bagasse as recommended by IPCC methodology, we will obtain wrong results, because great part of the produced bagase is used in paper manufacturing and not as fuel.

BOTTOM-UP METHOD

This is the method applied and explained in the present study. Since it uses consumption data about fuel directly supplied by consumers, it is not necessary to estimate the apparent consumption. This method makes it easy to determine CO_2 emissions from each sector and from the International consumption (oil bunkers).

RESULTS

The results obtained from both methods are shown in table A1. The top-down method includes the emissions from oil bunkers. This is because of the fact that, the bottom-up method does not estimate the oil bunker amount. It only considers the production but not the consumption. The difference of solid fuel emissions in the bottom-up method is because it considers the consumption of products from coal transformation in blast furnace. This consumption is not the same as the one considered in the top-down method.

Other differences are due to the uncertainity of the statistical information.

FUEL TYPE	BUTTOM-UP	TOP-DOWN	PERCENTAGE VARIATION (%)
Fossil liquid	17968.13	17999.59	+ 0.17
Fossil solid	477.73	531.80	+ 10.17
Fossil gas	1153.39	1198.49	+ 3.76
SUBTOTAL	19599.25	19729.88	+ 0.66
Biomass	15737.92	15732.52	- 0.03
TOTAL	35337.17	35462.40	+ 0.35
Oil Bunkers	256.76	----	----

Table A.1 Comparison of the inventories obtained through the methods "Top-Donw" and "Bottom-up" for 1990.

Making a summary of the emissions from oil bunker with the ones of the total from the buttom-up method, we have a result of: 35593.93 Gg of CO2. Making a comparison of this amount with the one obtained from the top-down method (35462.40 Gg) we have a difference of 0.37%. According to this we can assert that both methods are consistent.

APPENDIX B

B.1 This appendix presents detailed estimates of the CO_2 Inventories according to the top-down and bottom-up methods and using the IPCC methodology for 1990.

Table B.1 shows the National CO_2 Inventory according to the top-down method.

Table B.2 shows the National CO_2 Inventory according to the bottom-up method.

Table B.3 shows the National CO_2 Inventory for the Conversion Activity.

Table B.4 shows the National CO_2 Inventory for the Transportation Sector.

Table B.5 shows the National CO_2 Inventory for the Industrial Sector.

Table B.6 shows the National CO_2 Inventory for the Residential Subsector.

Table B.7 Shows the National CO_2 Inventory for the Mininig-Metallurgy Subsector.

Table B.8 shows the National CO_2 Inventory for the Fishing Subsector.

Table B.9 shows the National CO_2 Inventory for the Public Services Subsector.

Table B.10 shows the National CO_2 Inventory for the Agriculture and cattle/ Agricultural industry Activity Subsector.

NATIONAL INVENTORY OF CO2 EMISSION

TOP DOWN INVENTORY

Module				*ENERGY*					
Sub Module				*CO2 FROM ENERGY SOURCES (DETAILED FUELS APPROACH)*					
WORKSHEET				*I - 1*					
SHEET				A					
				STEP I					
				A	B	C	D	E	F
				Production	*Imports*	*Exports*	*Stock Change*	Not use Energy and Adjust	*Aparent Consumption (kTEP)*
Fuels Types									*F=(A+B-C-D+*
Liquid Fossil	*Primary Fuels*	*Crude Oil*		*6492.86*	*887.88*	*149.52*	*82.36*	282.85	*7431.71*
	Secondary Fuels	*Gasoline (aviation & motor)*			*36.49*	*72.81*	*0.98*		*-37.30*
		Kerosene			*70.63*	*0.00*	*-7.57*		*78.20*
		Jet Fuel			*0.00*	*0.00*	*0.00*		*0.00*
		Residual fuel Oil			*0.00*	*2030.58*	*-16.92*		*-2013.66*
		LPG			*63.21*	*0.00*	*-2.91*		*66.12*
		Naphtha							*0.00*
		Bitumen							*0.00*
		Lubricants			*9.46*	*0.00*	*0.89*		*8.58*
		Petroleun Coque							*0.00*
		Refinery Gas					0.74		*-0.74*
		Refinary Feedstoscks							*0.00*
		Diesel Oil			*520.11*	*11.21*	*5.72*		*503.18*
Liquid Fossil Total				**6492.86**	***1587.78***	**2264.12**	**63.29**		**6036.09**
Solid Fossil	*Primary Fuels*	*Cooking Coal*		*68.26*	*29.86*	*0.00*	*-6.49*	-14.79	*89.82*
		Steam Coal							*0.00*
		Lignite							*0.00*
		Sub Bituminous							*0.00*
		Peat							*0.00*
	Secondary Fuels	Coke	*Industrial Ga*		*0.00*	*0.00*	*0.00*		*0.00*
			Coke		*41.27*	*0.00*			*41.27*
Solid Fossil Total				**68.26**	**71.13**	**0.00**	**-6.49**	***-14.79***	***131.09***
Gas Fossil	*Primary Fuels*	*Natural Gas (Dry)*		*757.34*	*0.00*	*0.00*	*185.08*	-59.44	*512.82*
	Secondary Fuels	*Distributed Gas*			0.00	0.00	0.00		*0.00*
TOTAL									*6680.00*
Burkers Oils		*Jet Fuel*							*0.00*
		Diesel Oil							*0.00*
		Residual Fuel Oil							*0.00*
		Aviation Gasoline							*0.00*
		Total Bunkers							**0.00**
Biomass		*Solid Biomass*	*Wood*	*3515.82*	*0.00*	*0.00*	*0.00*	0.00	*3515.82*
			Dung	*259.49*	*0.00*	*0.00*	*0.00*	0.00	*259.49*
			Bagasse	*316.60*	*0.00*	*0.00*	*0.00*	-148.26 *	*168.34*
			Charcoal	*0.00*	*0.00*	*0.00*	*0.00*	0.00	*0.00*
		Total Biomass		***4091.91***	***0.00***	***0.00***	***0.00***	***-148.26***	***3943.65***

* *Quanlity use like non energy and adjusts*

Table B.1 National CO2 Inventory according to the top-down method.

NATIONAL INVENTORY OF CO2 EMISSION

TOP DOWN INVENTORY

Module				*ENERGY*				
Sub Module				*CO2 FROM ENERGY SOURCES (DETAILED FUELS APPR*				
WORKSHEET				*I - 1*				
SHEET				*B*				
				STEP II		*STEP III*		
				F	*G*	*H*	*I*	*J*
				Factor Conversio	*Apparent Consumptio (GJ)*	*Factor Emission (kg C/GJ)*	*Fraction Carbon (kg C)*	*Fraction Carbon*
Fuels Types					*G=(E*F)*		*I=(G*H)*	*J=(I*10^-*
Liquid Fossil	*Primary Fuels*	*Crude Oil*		*41868*	*3.11E+08*	*20*	*6.2E+09*	*6223.02*
	Secondary Fuels	*Gasoline (aviation & motor)*		*41868*	*-1.56E+06*	*18.9*	*-3E+07*	*-29.52*
		Kerosene		*41868*	*3.27E+06*	*19.6*	*6.4E+07*	*64.17*
		Jet Fuel		*41868*	*0.00E+00*	*19.5*	*0*	*0.00*
		Residual fuel Oil		*41868*	*-8.43E+07*	*21.1*	*-1.8E+09*	*-1778.90*
		LPG		*41868*	*2.77E+06*	*17.2*	*4.8E+07*	*47.61*
		Naphtha		*41868*	*0.00E+00*	*NA(20.0)*	*0*	*0.00*
		Bitumen		*41868*	*0.00E+00*	*22*	*0*	*0.00*
		Lubricants		*41868*	*3.59E+05*	*20*	*7180362*	*7.18*
		Petroleun Coque		*41868*	*0.00E+00*	*27.5*	*0*	*0.00*
		Refinery Gas		41868	-3.10E+04	18.2	-563878	-0.56
		Refinery Feedstoscks		*41868*	*0.00E+00*	*NA(20.0)*	*0*	*0.00*
		Diesel Oil		*41868*	*2.11E+07*	*20.2*	*4.3E+08*	*425.56*
Liquid Fossil Total					**2.53E+08**		**5E+09**	**4958.56**
Solid Fossil	*Primary Fuels*	*Cooking Coal*		*41868*	*3.76E+06*	*25.8*	*9.7E+07*	*97.02*
		Steam Coal		*41868*	*0.00E+00*	*25.8*	*0*	*0.00*
		Lignite		*41868*	*0.00E+00*	*27.6*	*0*	*0.00*
		Sub Bituminous		*41868*	*0.00E+00*	*26.2*	*0*	*0.00*
		Peat		41868	*0.00E+00*	*28.9*		
	Secondary Fuels	*Coke*	*Industrial Ga*	*41868*	*0.00E+00*	*15.3*	*0*	*0.00*
			Coke	*41868*	*1.73E+06*	*29.5*	*5.1E+07*	*50.97*
Solid Fossil Total					***5.49E+06***		***1.5E+08***	***148.00***
Gas Fossil	*Primary Fuels*	*Natural Gas (Dry)*		*41868*	*2.15E+07*	*15.3*	*3.3E+08*	*328.50*
	Secondary Fuels	*Distributed Gas*		41868	*0.00E+00*	15.2	*0*	*0.00*
TOTAL					***2.80E+08***		***5E+09***	***5435.06***
Burkers Oils		*Jet Fuel*		*41868*	*0.00E+00*	*19.5*	*0*	*0.00*
		Diesel Oil		*41868*	*0.00E+00*	*20.2*	*0*	*0.00*
		Residual Fuel Oil		*41868*	*0.00E+00*	*21.1*	*0*	*0.00*
		Aviation Gasoline		*41868*	*0.00E+00*	*18.9*	*0*	*0.00*
		Total Bunkers			***0.00E+00***		***0***	***0.00***
Biomass		*Solid Biomass*	*Wood*	*41868*	*1.47E+08*	*29.9*	*4.4E+09*	*4401.29*
			Dung	*41868*	*1.09E+07*	*29.9*	*3.2E+08*	*324.84*
			Bagasse	*41868*	*7.05E+06*	*29.9*	*2.1E+08*	*210.74*
			Charcoal	*41868*	*0.00E+00*	*29.9*	*0*	*0.00*
		Total Biomass			***1.65E+08***		***4.9E+09***	***4936.87***

Continuation of the table B.1

NATIONAL INVENTORY OF CO2 EMISSION

TOP DOWN INVENTORY

Module				ENERGY				
Sub Module				CO2 FROM ENERGY SOURCES (DETAILED FUELS APPROACH)				
WORKSHEET				I - 1				
SHEET				C				
				STEP IV		STEP V		STEP VI
				K	L	M	N	O
				Carbon Stored (Gg C)	Net Carbon Emission (Gg C)	Fraction Carbon Oxidized (kg C/GJ)	Actual Carbon Emission (Gg C)	Actual CO2 Emission (Gg CO2)
Fuels Types					L=(J-K)		N=(L*M)	O=(N*(44/12))
Liquid Fossil	Primary Fuels	Crude Oil		0.00	6223.02	0.990	6160.79	22589.55
	Secondary Fuels	Gasoline (aviation & motor)		0.00	-29.52	0.990	-29.22	-107.14
		Kerosene		0.00	64.17	0.990	63.53	232.94
		Jet Fuel		0.00	0.00	0.990	0.00	0.00
		Residual fuel Oil		0.00	-1778.90	0.990	-1761.11	-6457.40
		LPG		0.00	47.61	0.990	47.14	172.84
		Naphtha		0.00	0.00	0.990	0.00	0.00
		Bitumen		0.00	0.00	0.990	0.00	0.00
		Lubricants		0.00	7.18	0.990	7.11	26.06
		Petroleun Coque		0.00	0.00	0.990	0.00	0.00
		Refinery Gas		0.00	-0.56	0.990	-0.56	-2.05
		Refinery Feedstoscks		0.00	0.00	0.990	0.00	0.00
		Diesel Oil		0.00	425.56	0.990	421.30	1544.77
Liquid Fossil Total					**4958.56**		**4908.98**	**17999.59**
Solid Fossil	Primary Fuels	Cooking Coal		0.00	97.02	0.980	95.08	348.64
		Steam Coal		0.00	0.00	0.980	0.00	0.00
		Lignite		0.00	0.00	0.980	0.00	0.00
		Sub Bituminous		0.00	0.00	0.980	0.00	0.00
		Peat		0.00	0.00	0.980	0.00	0.00
	Secondary Fuels	Coke	Industrial Gas	0.00	0.00	0.995	0.00	0.00
			Coke	0.00	50.97	0.980	49.95	183.16
Solid Fossil Total					**148.00**		**145.04**	**531.80**
Gas Fossil	Primary Fuels	Natural Gas (Dry)		0.00	328.50	0.995	326.86	1198.49
	Secondary Fuels	Distributed Gas		0.00	0.00	0.995	0.00	0.00
TOTAL					**5435.06**		**5380.87**	**19729.87**
Burkers Oils		Jet Fuel		0.00	0.00	0.990	0.00	0.00
		Diesel Oil		0.00	0.00	0.990	0.00	0.00
		Residual Fuel Oil		0.00	0.00	0.990	0.00	0.00
		Aviation Gasoline		0.00	0.00	0.990	0.00	0.00
		Total Bunkers			**0.00**		**0.00**	**0.00**
Biomass		Solid Biomass	Wood	0.00	4401.29	0.870	3829.12	14040.12
			Dung	0.00	324.84	0.850	276.12	1012.43
			Bagasse	0.00	210.74	0.880	185.45	679.98
			Charcoal	0.00	0.00	0.880	0.00	0.00
		Total Biomass			**4936.87**		**4290.69**	**15732.52**

Continuation of the table B.1

NATIONAL INVENTORY OF CO2 EMISSION

BUTTOM TO UP INVENTORY

Module				ENERGY				
Sub Module				CO2 FROM ENERGY SOURCES (DETAILED FUELS APP				
WORKSHEET				I - 1				
SHEET				A				
				STEP 1				
				A	B	C	D	E
				Productio	Imports	Exports	Stock Change	Aparent Consumption
Fuels Types								E=(A+B-C-D)
Liquid Fossil	Primary Fuels	Crude Oil						49.04
	Secondary Fuels	Gasoline (aviation & motor)						1243.29
		Kerosene						692.81
		Jet Fuel						197.07
		Residual fuel Oil						1607.55
		LPG						188.80
		Naphtha						0.00
		Bitumen						0.00
		Lubricantes						19.65
		Petroleun Coque						0.00
		Refinery Gas						68.63
		Refinery Feedstocks						0.00
		Diesel Oil						1857.26
Liquid Fossil Total								**5924.10**
Solid Fossil	Primary Fuels	Cooking Coal						66.80
		Steam Coal						0.00
		Lignite						0.00
		Sub Bituminous						0.00
		Peat						0.00
	Secondary Fuels	Coke	Industrial Ga					16.35
			Coke					40.61
Solid Fossil Total								**123.76**
Gas Fossil	Primary Fuels	Natural Gas (Dry)						0.00
	Secondary Fuels	Distributed Gas						496.77
TOTAL								6544.63
Burkers Oils		Jet Fuel						84.06
		Diesel Oil						2.04
		Residual Fuel Oil						0.41
		Aviation Gasoline						0.02
		Total Bunkers						**86.53**
Biomass		Solid Biomass	Wood					3391.93
			Dung					259.51
			Bagasse					168.24
			Charcoal					123.90
		Total Biomass						**3943.58**

Table B.2 National CO2 Inventory according to the bottom-up method.

NATIONAL INVENTORY OF CO2 EMISSION

BUTOM TO UP INVENTORY

Module				ENERGY				
Sub Module				CO2 FROM ENERGY SOURCES (DETAILED FUELS APPRO				
WORKSHEET				I - 1				
SHEET				B				
				STEP II		STEP III		
				F	G	H	I	J
				Factor Conversio	Apparent Consumptio (GJ)	Factor Emission (kg C/GJ)	Fraction Carbon (kg C)	Fraction Carbon
Fuels Types					G=(E*F)		I=(G*H)	J=(I*10^-
Liquid Fossil	Primary Fuels	Crude Oil		41868	2.05E+06	20	4.1E+07	41.06
	Secondary Fuels	Gasoline (aviation & motor)		41868	5.21E+07	18.9	9.8E+08	983.82
		Kerosene		41868	2.90E+07	19.6	5.7E+08	568.53
		Jet Fuel		41868	8.25E+06	19.5	1.6E+08	160.89
		Residual fuel Oil		41868	6.73E+07	21.1	1.4E+09	1420.13
		LPG		41868	7.90E+06	17.2	1.4E+08	135.96
		Naphtha		41868	0.00E+00	NA(20.0)	0	0.00
		Bitumen		41868	0.00E+00	22	0	0.00
		Lubricantes		41868	8.23E+05	20	1.6E+07	16.45
		Petroleun Coque		41868	0.00E+00	27.5	0	0.00
		Refinery Gas		41868	2.87E+06	18.2	5.2E+07	52.30
		Refinery Feedstoscks		41868	0.00E+00	NA(20.0)	0	0.00
		Diesel Oil		41868	7.78E+07	20.2	1.6E+09	1570.75
Liquid Fossil Total					**2.48E+08**		**4.9E+09**	**4949.90**
Solid Fossil	Primary Fuels	Cooking Coal		41868	2.80E+06	25.8	7.2E+07	72.16
		Steam Coal		41868	0.00E+00	25.8	0	0.00
		Lignite		41868	0.00E+00	27.6	0	0.00
		Sub Bituminous		41868	0.00E+00	26.2	0	0.00
		Peat		41868	0.00E+00	28.9		
	Secondary Fuels	Coke	Industrial Gas	41868	6.85E+05	15.3	1E+07	10.47
			Coke	41868	1.70E+06	29.5	5E+07	50.16
Solid Fossil Total					**5.18E+06**		**1.3E+08**	**132.79**
Gas Fossil	Primary Fuels	Natural Gas (Dry)		41868	0.00E+00	15.3	0	0.00
	Secondary Fuels	Distributed Gas		41868	2.08E+07	15.2	3.2E+08	316.14
TOTAL					2.74E+08		5.4E+09	5398.83
Burkers Oils		Jet Fuel		41868	3.52E+06	19.5	6.9E+07	68.63
		Diesel Oil		41868	8.54E+04	20.2	1725297	1.73
		Residual Fuel Oil		41868	1.72E+04	21.1	362200	0.36
		Aviation Gasoline		41868	8.37E+02	18.9	15826.1	0.02
		Total Bunkers			**3.62E+06**		**7.1E+07**	**70.73**
Biomass		Solid Biomass	Wood	41868	1.42E+08	29.9	4.2E+09	4246.20
			Dung	41868	1.09E+07	29.9	3.2E+08	324.87
			Bagasse	41868	7.04E+06	29.9	2.1E+08	210.61
			Charcoal	41868	5.19E+06	29.9	1.6E+08	155.10
		Total Biomass			**1.65E+08**		**4.9E+09**	**4936.78**

Continuation of the Table B.2

NATIONAL INVENTORY OF CO2 EMISSION

BUTTOM TO UP INVENTORY

Module				ENERGY				
Sub Module				CO2 FROM ENERGY SOURCES (DETAILED FUELS APPRO				
WORKSHEET				I - 1				
SHEET				C				
				STEP IV		STEP V		STEP VI
				K	L	M	N	O
				Carbon Stored (Gg C)	Net Carbon Emission (Gg C)	Fraction Carbon Oxidized (kg C/GJ)	Actual Carbon Emission (Gg C)	Actual CO2 Emission (Gg CO2)
Fuels Types					L=(J-K)		N=(L*M)	O=(N*(44/12
Liquid Fossil	Primary Fuels	Crude Oil		0.00	41.06	0.990	40.65	149.06
	Secondary Fuels	Gasoline (aviation & motor)		0.00	983.82	0.990	973.98	3571.27
		Kerosene		0.00	568.53	0.990	562.84	2063.76
		Jet Fuel		0.00	160.89	0.990	159.28	584.04
		Residual fuel Oil		0.00	1420.13	0.990	1405.93	5155.08
		LPG		0.00	135.96	0.990	134.60	493.54
		Naphtha		0.00	0.00	0.990	0.00	0.00
		Bitumen		0.00	0.00	0.990	0.00	0.00
		Lubricantes		0.00	16.45	0.990	16.29	59.73
		Petroleun Coque		0.00	0.00	0.990	0.00	0.00
		Refinery Gas		0.00	52.30	0.990	51.77	189.83
		Refinery Feedstoscks		0.00	0.00	0.990	0.00	0.00
		Diesel Oil		0.00	1570.75	0.990	1555.04	5701.81
Liquid Fossil Total					**4949.90**		**4900.40**	**17968.13**
Solid Fossil	Primary Fuels	Cooking Coal		0.00	72.16	0.980	70.71	259.28
		Steam Coal		0.00	0.00	0.980	0.00	0.00
		Lignite		0.00	0.00	0.980	0.00	0.00
		Sub Bituminous		0.00	0.00	0.980	0.00	0.00
		Peat		0.00	0.00	0.980	0.00	0.00
	Secondary Fuels	Coke	Industrial Gas	0.00	10.47	0.995	10.42	38.21
			Coke	0.00	50.16	0.980	49.15	180.23
Solid Fossil Total					**132.79**		**130.29**	**477.73**
Gas Fossil	Primary Fuels	Natural Gas (Dry)		0.00	0.00	0.995	0.00	0.00
	Secondary Fuels	Distributed Gas		0.00	316.14	0.995	314.56	1153.39
TOTAL					5398.83		5345.25	19599.25
Burkers Oils		Jet Fuel		0.00	68.63	0.990	67.94	249.12
		Diesel Oil		0.00	1.73	0.990	1.71	6.26
		Residual Fuel Oil		0.00	0.36	0.990	0.36	1.31
		Aviation Gasoline		0.00	0.02	0.990	0.02	0.06
		Total Bunkers			**70.73**		**70.02**	**256.76**
Biomass		Solid Biomass	Wood	0.00	4246.20	0.870	3694.19	13545.37
			Dung	0.00	324.87	0.850	276.14	1012.51
			Bagasse	0.00	210.61	0.880	185.34	679.57
			Charcoal	0.00	155.10	0.880	136.49	500.47
		Total Biomass			**4936.78**		**4292.16**	**15737.92**

Continuation of the Table B.2

CONVERSION

BUTTOM TO UP INVENTORY

Module				*ENERGY*				
Sub Module				*CO2 FROM ENERGY SOURCES (DETAILED FUELS APPRO*				
WORKSHEET				*I - 1*				
SHEET				*A*				
				STEP 1				
				A	*B*	*C*	*D*	*E*
				Productio	*Imports*	*Exports*	*Stock Change*	*Aparent Consumption*
Fuels Types								*E=(A+B-C-D)*
Liquid Fossil	*Primary Fuels*	*Crude Oil*						*49.04*
	Secondary Fuels	*Gasoline (aviation & motor)*						*3.50*
		Kerosene						*2.60*
		Jet Fuel						*0.00*
		Residual fuel Oil						*420.20*
		LPG						*0.00*
		Naphtha						*0.00*
		Bitumen						*0.00*
		Lubricantes						*0.00*
		Petroleun Coque						*0.00*
		Refinery Gas						*68.63*
		Refinery Feedstoscks						*0.00*
		Diesel Oil						*497.00*
Liquid Fossil Total								***1040.97***
Solid Fossil	*Primary Fuels*	*Cooking Coal*						*3.02*
		Steam Coal						*0.00*
		Lignite						*0.00*
		Sub Bituminous						*0.00*
		Peat						*0.00*
	Secondary Fuels	Coke	*Industrial Ga*					*6.95*
			Coke					*13.77*
Solid Fossil Total								***23.74***
Gas Fossil	*Primary Fuels*	*Natural Gas (Dry)*						*0.00*
	Secondary Fuels	*Distributed Gas*						*422.47*
TOTAL								*1487.18*
Burkers Oils		*Jet Fuel*						*0.00*
		Diesel Oil						*0.00*
		Residual Fuel Oil						*0.00*
		Aviation Gasoline						*0.00*
		Total Bunkers						***0.00***
Biomass		*Solid Biomass*	*Wood*					*185.81*
			Dung					*0.00*
			Bagasse					*45.40*
			Charcoal					*0.00*
		Total Biomass						***231.21***

Table B.3 National CO2 Inventory for the Conversion Activity

CONVERSION

BUTOM TO UP INVENTORY

Module				ENERGY				
Sub Module				CO2 FROM ENERGY SOURCES (DETAILED FUELS APPROA				
WORKSHEET				I - 1				
SHEET				B				
				STEP II		STEP III		
				F	G	H	I	J
				Factor Conversio	Apparent Consumption (GJ)	Factor Emission (kg C/GJ)	Fraction Carbon (kg C)	Fraction Carbon
Fuels Types					G=(E*F)		I=(G*H)	J=(I*10^-
Liquid Fossil	Primary Fuels	Crude Oil		41868	2.05E+06	20	41064134	41.06
	Secondary Fuels	Gasoline (aviation & motor)		41868	1.47E+05	18.9	2769568	2.77
		Kerosene		41868	1.09E+05	19.6	2133593	2.13
		Jet Fuel		41868	0.00E+00	19.5	0	0.00
		Residual fuel Oil		41868	1.76E+07	21.1	3.71E+08	371.21
		LPG		41868	0.00E+00	17.2	0	0.00
		Naphtha		41868	0.00E+00		0	0.00
		Bitumen		41868	0.00E+00	22	0	0.00
		Lubricantes		41868	0.00E+00	20	0	0.00
		Petroleun Coque		41868	0.00E+00	27.5	0	0.00
		Refinery Gas		41868	2.87E+06	18.2	52295895	52.30
		Refinery Feedstocks		41868	0.00E+00		0	0.00
		Diesel Oil		41868	2.08E+07	20.2	4.2E+08	420.33
Liquid Fossil Total					**4.36E+07**		**8.9E+08**	**889.80**
Solid Fossil	Primary Fuels	Cooking Coal		41868	1.26E+05	25.8	3262187	3.26
		Steam Coal		41868	0.00E+00	25.8	0	0.00
		Lignite		41868	0.00E+00	27.6	0	0.00
		Sub Bituminous		41868	0.00E+00	26.2	0	0.00
		Peat		41868	0.00E+00	28.9		
	Secondary Fuels	Coke	Industrial Gas	41868	2.91E+05	15.3	4452034	4.45
			Coke	41868	5.77E+05	29.5	17007410	17.01
Solid Fossil Total					**9.94E+05**		**2.5E+07**	**24.72**
Gas Fossil	Primary Fuels	Natural Gas (Dry)		41868	0.00E+00	15.3	0	0.00
	Secondary Fuels	Distributed Gas		41868	1.77E+07	15.2	2.69E+08	268.86
TOTAL					**6.23E+07**		**1.2E+09**	**1183.38**
Burkers Oils		Jet Fuel		41868	0.00E+00	19.5	0	0.00
		Diesel Oil		41868	0.00E+00	20.2	0	0.00
		Residual Fuel Oil		41868	0.00E+00	21.1	0	0.00
		Aviation Gasoline		41868	0.00E+00	18.9	0	0.00
		Total Bunkers			**0.00E+00**		**0**	**0.00**
Biomass		Solid Biomass	Wood	41868	7.78E+06	29.9	2.33E+08	232.61
			Dung	41868	0.00E+00	29.9	0	0.00
			Bagasse	41868	1.90E+06	29.9	56834135	56.83
			Charcoal	41868	0.00E+00	29.9	0	0.00
		Total Biomass			**9.68E+06**		**2.9E+08**	**289.44**

Continuation of Table B.3

CONVERSION

BUTTOM TO UP INVENTORY

Module				ENERGY				
Sub Module				CO2 FROM ENERGY SOURCES (DETAILED FUELS APPRO				
WORKSHEET				I - 1				
SHEET				C				
				STEP IV		STEP V		STEP VI
				K	L	M	N	O
				Carbon Stored (Gg C)	Net Carbon Emission (Gg C)	Fraction Carbon Oxidized (kg C/GJ)	Actual Carbon Emission (Gg C)	Actual CO2 Emission (Gg CO2)
Fuels Types					L=(J-K)		N=(L*M)	O=(N*(44/12))
Liquid Fossil	Primary Fuels	Crude Oil		0.00	41.06	0.990	40.65	149.06
	Secondary Fuels	Gasoline (aviation & motor)		0.00	2.77	0.990	2.74	10.05
		Kerosene		0.00	2.13	0.990	2.11	7.74
		Jet Fuel		0.00	0.00	0.990	0.00	0.00
		Residual fuel Oil		0.00	371.21	0.990	367.50	1347.50
		LPG		0.00	0.00	0.990	0.00	0.00
		Naphtha		0.00	0.00	0.990	0.00	0.00
		Bitumen		0.00	0.00	0.990	0.00	0.00
		Lubricantes		0.00	0.00	0.990	0.00	0.00
		Petroleun Coque		0.00	0.00	0.990	0.00	0.00
		Refinery Gas		0.00	52.30	0.990	51.77	189.83
		Refinery Feedstoscks		0.00	0.00	0.990	0.00	0.00
		Diesel Oil		0.00	420.33	0.990	416.13	1525.80
Liquid Fossil Total					**889.80**		**880.91**	**3229.99**
Solid Fossil	Primary Fuels	Cooking Coal		0.00	3.26	0.980	3.20	11.72
		Steam Coal		0.00	0.00	0.980	0.00	0.00
		Lignite		0.00	0.00	0.980	0.00	0.00
		Sub Bituminous		0.00	0.00	0.980	0.00	0.00
		Peat		0.00	0.00	0.980	0.00	0.00
	Secondary Fuels	Coke	Industrial Gas	0.00	4.45	0.995	4.43	16.24
			Coke	0.00	17.01	0.980	16.67	61.11
Solid Fossil Total					**24.72**		**24.29**	**89.08**
Gas Fossil	Primary Fuels	Natural Gas (Dry)		0.00	0.00	0.995	0.00	0.00
	Secondary Fuels	Distributed Gas		0.00	268.86	0.995	267.51	980.88
TOTAL					1183.38		1172.71	4299.95
Burkers Oils		Jet Fuel		0.00	0.00	0.990	0.00	0.00
		Diesel Oil		0.00	0.00	0.990	0.00	0.00
		Residual Fuel Oil		0.00	0.00	0.990	0.00	0.00
		Aviation Gasoline		0.00	0.00	0.990	0.00	0.00
		Total Bunkers			**0.00**		**0.00**	**0.00**
Biomass		Solid Biomass	Wood	0.00	232.61	0.870	202.37	742.02
			Dung	0.00	0.00	0.850	0.00	0.00
			Bagasse	0.00	56.83	0.880	50.01	183.38
			Charcoal	0.00	0.00	0.880	0.00	0.00
		Total Biomass			**289.44**		**252.38**	**925.40**

Continuation of Table B.3

TRANSPORTATION SECTOR

BUTTOM TO UP INVENTORY

Module				ENERGY				
Sub Module				CO2 FROM ENERGY SOURCES (DETAILED FUELS APPRO				
WORKSHEET				I - 1				
SHEET				A				
				STEP I				
				A	B	C	D	E
				Productio	Imports	Exports	Stock Change	Aparent Consumption
Fuels Types								E=(A+B-C-D)
Liquid Fossil	Primary Fuels	Crude Oil						0.00
	Secondary Fuels	Gasoline (aviation & motor)						1148.38
		Kerosene						0.00
		Jet Fuel						137.10
		Residual fuel Oil						99.99
		LPG						0.00
		Naphtha						0.00
		Bitumen						0.00
		Lubricantes						11.23
		Petroleun Coque						0.00
		Refinery Gas						0.00
		Refinery Feedstoscks						0.00
		Diesel Oil						1033.16
Liquid Fossil Total								**2429.86**
Solid Fossil	Primary Fuels	Cooking Coal						0.00
		Steam Coal						0.00
		Lignite						0.00
		Sub Bituminous						0.00
		Peat						0.00
	Secondary Fuels	Coke	Industrial Ga					0.00
			Coke					0.00
Solid Fossil Total								**0.00**
Gas Fossil	Primary Fuels	Natural Gas						0.00
	Secondary Fuels	Distributed Gas(Gas dry)						0.00
TOTAL								2429.86
Burkers Oils		Jet Fuel						84.06
		Diesel Oil						2.04
		Residual Fuel Oil						0.41
		Aviation Gasoline						0.02
		Total Bunkers						86.53
Biomass		Solid Biomass	Wood					0.00
			Dung					0.00
			Bagasse					0.00
			Charcoal					0.00
		Total Biomass						0.00

Table B.4 National CO2 Inventory for the Transportation Sector

TRANSPORTATION SECTOR

BUTOM TO UP INVENTORY

Module				*ENERGY*				
Sub Module				*CO2 FROM ENERGY SOURCES (DETAILED FUELS APPROA*				
WORKSHEET				*I - 1*				
SHEET						*B*		
				STEP II		*STEP III*		
				F	*G*	*H*	*I*	*J*
				Factor Conversio	*Apparent Consumption (GJ)*	*Factor Emission (kg C/GJ)*	*Fraction Carbon (kg C)*	*Fraction Carbon*
Fuels Types					*G=(E*F)*		*I=(G*H)*	*J=(I*10^-*
Liquid Fossil	*Primary Fuels*	*Crude Oil*				20		
	Secondary Fuels	*Gasoline (aviation & motor)*		41868	4.81E+07	18.9	9.09E+08	908.72
		Kerosene		41868	0.00E+00	19.6	0	0.00
		Jet Fuel		41868	5.74E+06	19.5	1.12E+08	111.93
		Residual fuel Oil		41868	4.19E+06	21.1	88332646	88.33
		LPG		41868	0.00E+00	17.2	0	0.00
		Naphtha		41868	0.00E+00		0	0.00
		Bitumen		41868	0.00E+00	22	0	0.00
		Lubricantes		41868	4.70E+05	20	9403553	9.40
		Petroleun Coque		41868	0.00E+00	27.5	0	0.00
		Refinery Gas		41868	0.00E+00	18.2	0	0.00
		Refinery Feedstocks		41868	0.00E+00		0	0.00
		Diesel Oil		41868	4.33E+07	20.2	8.74E+08	873.78
Liquid Fossil Total					1.02E+08		2E+09	1992.17
Solid Fossil	*Primary Fuels*	*Cooking Coal*		41868	0.00E+00	25.8	0	0.00
		Steam Coal		41868	0.00E+00	25.8	0	0.00
		Lignite		41868	0.00E+00	27.6	0	0.00
		Sub Bituminous		41868	0.00E+00	26.2	0	0.00
		Peat		41868	0.00E+00	28.9		
	Secondary Fuels	Coke	*Industrial Gas*	41868	0.00E+00	15.3	0	0.00
			Coke	41868	0.00E+00	29.5	0	0.00
Solid Fossil Total					0.00E+00		0	0.00
Gas Fossil	*Primary Fuels*	*Natural Gas*		41868	0.00E+00	15.3	0	0.00
	Secondary Fuels	*Distributed Gas(Gas dry)*		41868	0.00E+00	15.2	0	0.00
TOTAL					1.02E+08		2.0E+09	1992.17
Burkers Oils		*Jet Fuel*		41868	3.52E+06	19.5	68628770	68.63
		Diesel Oil		41868	8.54E+04	20.2	1725297	1.73
		Residual Fuel Oil		41868	1.72E+04	21.1	362200.1	0.36
		Aviation Gasoline		41868	8.37E+02	18.9	15826.1	0.02
		Total Bunkers			3.62E+06		7.1E+07	70.73
Biomass		*Solid Biomass*	*Wood*	41868	0.00E+00	29.9	0	0.00
			Dung	41868	0.00E+00	29.9	0	0.00
			Bagasse	41868	0.00E+00	29.9	0	0.00
			Charcoal	41868	0.00E+00	29.9	0	0.00
		Total Biomass			0.00E+00		0	0.00

Continuation of Table B.4

TRANSPORTATION SECTOR

BUTTOM TO UP INVENTORY

Module				ENERGY					
Sub Module				CO2 FROM ENERGY SOURCES (DETAILED FUELS APPRO					
WORKSHEET				I - 1					
SHEET				C					
				STEP IV		STEP V		STEP VI	
				K	L	M	N	O	
				Carbon Stored (Gg C)	Net Carbon Emission (Gg C)	Fraction Carbon Oxidized (kg C/GJ)	Actual Carbon Emission (Gg C)	Actual CO2 Emission (Gg CO2)	
Fuels Types					L=(J-K)		N=(L*M)	O=(N*(44/12)	
Liquid Fossil	Primary Fuels	Crude Oil		0.00	0.00	0.990	0.00	0.00	
	Secondary Fuels	Gasoline (aviation & motor)		0.00	908.72	0.990	899.63	3298.65	
		Kerosene		0.00	0.00	0.990	0.00	0.00	
		Jet Fuel		0.00	111.93	0.990	110.81	406.31	
		Residual fuel Oil		0.00	88.33	0.990	87.45	320.65	
		LPG		0.00	0.00	0.990	0.00	0.00	
		Naphtha		0.00	0.00	0.990	0.00	0.00	
		Bitumen		0.00	0.00	0.990	0.00	0.00	
		Lubricantes		0.00	9.40	0.990	9.31	34.13	
		Petroleun Coque		0.00	0.00	0.990	0.00	0.00	
		Refinery Gas		0.00	0.00	0.990	0.00	0.00	
		Refinery Feedstoscks		0.00	0.00	0.990	0.00	0.00	
		Diesel Oil		0.00	873.78	0.990	865.04	3171.81	
Liquid Fossil Total					**1992.17**		**1972.24**	**7231.56**	
Solid Fossil	Primary Fuels	Cooking Coal		0.00	0.00	0.980	0.00	0.00	
		Steam Coal		0.00	0.00	0.980	0.00	0.00	
		Lignite		0.00	0.00	0.980	0.00	0.00	
		Sub Bituminous		0.00	0.00	0.980	0.00	0.00	
		Peat		0.00	0.00	0.980	0.00	0.00	
	Secondary Fuels	Coke	Industrial Gas	0.00	0.00	0.995	0.00	0.00	
			Coke	0.00	0.00	0.980	0.00	0.00	
Solid Fossil Total					**0.00**		**0.00**	**0.00**	
Gas Fossil	Primary Fuels	Natural Gas		0.00	0.00	0.995	0.00	0.00	
	Secondary Fuels	Distributed Gas(Gas dry)		0.00	0.00	0.995	0.00	0.00	
TOTAL					1992.17		1972.24	7231.56	
Burkers Oils		Jet Fuel		0.00	68.63	0.990	67.94	249.12	
		Diesel Oil		0.00	1.73	0.990	1.71	6.26	
		Residual Fuel Oil		0.00	0.36	0.990	0.36	1.31	
		Aviation Gasoline		0.00	0.02	0.990	0.02	0.06	
		Total Bunkers			**70.73**		**70.02**	**256.76**	
Biomass		Solid Biomass	Wood	0.00	0.00	0.870	0.00	0.00	
			Dung	0.00	0.00	0.850	0.00	0.00	
			Bagasse	0.00	0.00	0.880	0.00	0.00	
			Charcoal	0.00	0.00	0.880	0.00	0.00	
		Total Biomass			**0.00**		**0.00**	**0.00**	

Continuation of Table B.4

INDUSTRIAL SECTOR

BUTTOM TO UP INVENTORY

Module				ENERGY				
Sub Module				CO2 FROM ENERGY SOURCES (DETAILED FUELS APPRO				
WORKSHEET				I - 1				
SHEET				A				
				STEP I				
				A	B	C	D	E
				Productio	Imports	Exports	Stock Change	Aparent Consumption
Fuels Types								E=(A+B-C-D)
Liquid Fossil	Primary Fuels	Crude Oil						0.00
	Secondary Fuels	Gasoline (aviation & motor)						3.35
		Kerosene						1.40
		Jet Fuel						0.00
		Residual fuel Oil						559.20
		LPG						0.00
		Naphtha						0.00
		Bitumen						0.00
		Lubricants						2.10
		Petroleun Coque						0.00
		Refinery Gas						0.00
		Refinery Feedstoscks						0.00
		Diesel Oil						92.40
Liquid Fossil Total								**658.45**
Solid Fossil	Primary Fuels	Cooking Coal						48.50
		Steam Coal						0.00
		Lignite						0.00
		Sub Bituminous						0.00
		Peat						0.00
	Secondary Fuels	Coke	Industrial Ga					9.40
			Coke					0.00
Solid Fossil Tot	**Solid Fosil Total**							**57.90**
Gas Fossil	Primary Fuels	Natural Gas						0.00
	Secondary Fuels	Distributed Gas(Gas dry)						28.40
TOTAL								744.75
Burkers Oils		Jet Fuel						0.00
		Diesel Oil						0.00
		Residual Fuel Oil						0.00
		Aviation Gasoline						0.00
		Total Bunkers						**0.00**
Biomass		Solid Biomass	Wood					444.61
			Dung					0.00
			Bagasse					0.00
			Charcoal					0.00
		Total Biomass						**444.61**

Table B.5 National CO2 Inventory for the Industrial sector

INDUSTRIAL SECTOR

BUTOM TO UP INVENTORY

Module				ENERGY				
Sub Module				CO2 FROM ENERGY SOURCES (DETAILED FUELS APPROA				
WORKSHEET				I - 1				
SHEET				B				
				STEP II			STEP III	
				F	G	H	I	J
				Factor Conversio	Apparent Consumption (GJ)	Factor Emission (kg C/GJ)	Fraction Carbon (kg C)	Fraction Carbon
Fuels Types					G=(E*F)		I=(G*H)	J=(I*10^-
Liquid Fossil	Primary Fuels	Crude Oil				20		
	Secondary Fuels	Gasoline (aviation & motor)		41868	1.40E+05	18.9	2650872	2.65
		Kerosene		41868	5.86E+04	19.6	1148858	1.15
		Jet Fuel		41868	0.00E+00	19.5	0	0.00
		Residual fuel Oil		41868	2.34E+07	21.1	4.94E+08	494.01
		LPG		41868	0.00E+00	17.2	0	0.00
		Naphtha		41868	0.00E+00		0	0.00
		Bitumen		41868	0.00E+00	22	0	0.00
		Lubricants		41868	8.79E+04	20	1758456	1.76
		Petroleun Coque		41868	0.00E+00	27.5	0	0.00
		Refinery Gas		41868	0.00E+00	18.2	0	0.00
		Refinery Feedstoscks		41868	0.00E+00		0	0.00
		Diesel Oil		41868	3.87E+06	20.2	78145785	78.15
Liquid Fossil Total					**2.76E+07**		**5.8E+08**	**577.71**
Solid Fossil	Primary Fuels	Cooking Coal		41868	2.03E+06	25.8	52389428	52.39
		Steam Coal		41868	0.00E+00	25.8	0	0.00
		Lignite		41868	0.00E+00	27.6	0	0.00
		Sub Bituminous		41868	0.00E+00	26.2	0	0.00
		Peat		41868	0.00E+00	28.9		
	Secondary Fuels	Coke	Industrial Gas	41868	3.94E+05	15.3	6021456	6.02
			Coke	41868	0.00E+00	29.5	0	0.00
Solid Fossil Total					**2.42E+06**		**5.8E+07**	**58.41**
Gas Fossil	Primary Fuels	Natural Gas (Dry)		41868	0.00E+00	15.3	0	0.00
	Secondary Fuels	Distributed Gas		41868	1.19E+06	15.2	18073578	18.07
TOTAL					3.12E+07		6.5E+08	654.20
Burkers Oils		Jet Fuel		41868	0.00E+00	19.5	0	0.00
		Diesel Oil		41868	0.00E+00	20.2	0	0.00
		Residual Fuel Oil		41868	0.00E+00	21.1	0	0.00
		Aviation Gasoline		41868	0.00E+00	18.9	0	0.00
		Total Bunkers			**0.00E+00**		**0**	**0.00**
Biomass		Solid Biomass	Wood	41868	1.86E+07	29.9	5.57E+08	556.59
			Dung	41868	0.00E+00	29.9	0	0.00
			Bagasse	41868	0.00E+00	29.9	0	0.00
			Charcoal	41868	0.00E+00	29.9	0	0.00
		Total Biomass			**1.86E+07**		**5.6E+08**	**556.59**

Continuation of Table B.5

I INDUSTRIAL SECTOR

BUTTOM TO UP INVENTORY

Module				*ENERGY*				
Sub Module				*CO2 FROM ENERGY SOURCES (DETAILED FUELS APPRO*				
WORKSHEET				*I - 1*				
SHEET				C				
				STEP IV		*STEP V*		*STEP VI*
				K	*L*	*M*	*N*	*O*
				Carbon Stored (Gg C)	*Net Carbon Emission (Gg C)*	*Fraction Carbon Oxidized (kg C/GJ)*	*Actual Carbon Emission (Gg C)*	*Actual CO2 Emission (Gg CO2)*
Fuels Types					*L=(J-K)*		*N=(L*M)*	*O=(N*(44/12)*
Liquid Fossil	*Primary Fuels*	*Crude Oil*		0.00	0.00	0.990	0.00	0.00
	Secondary Fuels	*Gasoline (aviation & motor)*		0.00	2.65	0.990	2.62	9.62
		Kerosene		0.00	1.15	0.990	1.14	4.17
		Jet Fuel		0.00	0.00	0.990	0.00	0.00
		Residual fuel Oil		0.00	494.01	0.990	489.07	1793.25
		LPG		0.00	0.00	0.990	0.00	0.00
		Naphtha		0.00	0.00	0.990	0.00	0.00
		Bitumen		0.00	0.00	0.990	0.00	0.00
		Lubricants		0.00	1.76	0.990	1.74	6.38
		Petroleun Coque		0.00	0.00	0.990	0.00	0.00
		Refinery Gas		0.00	0.00	0.990	0.00	0.00
		Refinery Feedstoscks		0.00	0.00	0.990	0.00	0.00
		Diesel Oil		0.00	78.15	0.990	77.36	283.67
Liquid Fossil Total					**577.71**		**571.94**	**2097.10**
Solid Fossil	*Primary Fuels*	*Cooking Coal*		0.00	52.39	0.980	51.34	188.25
		Steam Coal		0.00	0.00	0.980	0.00	0.00
		Lignite		0.00	0.00	0.980	0.00	0.00
		Sub Bituminous		0.00	0.00	0.980	0.00	0.00
		Peat		0.00	0.00	0.980	0.00	0.00
	Secondary Fuels	Coke	*Industrial Gas*	0.00	6.02	0.995	5.99	21.97
			Coke	0.00	0.00	0.980	0.00	0.00
Solid Fossil Total					**58.41**		**57.33**	**210.22**
Gas Fossil	*Primary Fuels*	*Natural Gas (Dry)*		0.00	0.00	0.995	0.00	0.00
	Secondary Fuels	*Distributed Gas*		0.00	18.07	0.995	17.98	65.94
TOTAL					654.20		647.25	2373.26
Burkers Oils		*Jet Fuel*		0.00	0.00	0.990	0.00	0.00
		Diesel Oil		0.00	0.00	0.990	0.00	0.00
		Residual Fuel Oil		0.00	0.00	0.990	0.00	0.00
		Aviation Gasoline		0.00	0.00	0.990	0.00	0.00
		Total Bunkers			**0.00**		**0.00**	**0.00**
Biomass		*Solid Biomass*	*Wood*	0.00	556.59	0.870	484.23	1775.51
			Dung	0.00	0.00	0.850	0.00	0.00
			Bagasse	0.00	0.00	0.880	0.00	0.00
			Charcoal	0.00	0.00	0.880	0.00	0.00
		Total Biomass			**556.59**		**484.23**	**1775.51**

Continuation of Table B.5

RESIDENTIAL COMMERCIAL SUBSECTOR

BUTTOM TO UP INVENTORY

Module				ENERGY				
Sub Module				CO2 FROM ENERGY SOURCES (DETAILED FUELS APPRO				
WORKSHEET				1 - 1				
SHEET				A				
				STEP 1				
				A	B	C	D	E
				Productio	Imports	Exports	Stock Change	Aparent Consumption
Fuels Types								E=(A+B-C-D)
Liquid Fossil	Primary Fuels	Crude Oil						0.00
	Secondary Fuels	Gasoline (aviation & motor)						0.00
		Kerosene						683.24
		Jet Fuel						0.00
		Residual fuel Oil						0.00
		LPG						186.70
		Naphtha						0.00
		Bitumen						0.00
		Lubricantes						0.00
		Petroleun Coque						0.00
		Refinery Gas						0.00
		Refinery Feedstoscks						0.00
		Diesel Oil						0.00
Liquid Fossil Total								**869.94**
Solid Fossil	Primary Fuels	Cooking Coal						7.43
		Steam Coal						0.00
		Lignite						0.00
		Sub Bituminous						0.00
		Peat						0.00
	Secondary Fuels	Coke	Industrial Ga					0.00
			Coke					0.00
Solid Fossil Total								**7.43**
Gas Fossil	Primary Fuels	Natural Gas						0.00
	Secondary Fuels	Distributed Gas(Gas dry)						45.90
TOTAL								923.27
Burkers Oils		Jet Fuel						0.00
		Diesel Oil						0.00
		Residual Fuel Oil						0.00
		Aviation Gasoline						0.00
		Total Bunkers						**0.00**
Biomass		Solid Biomass	Wood					2761.51
			Dung					259.49
			Bagasse					0.00
			Charcoal					123.90
		Total Biomass						**3144.90**

Table B.6 National CO2 Inventory for the Residential-Commercial

RESIDENTIAL COMMERCIAL SUBSECTOR

BUTOM TO UP INVENTORY

Module				ENERGY					
Sub Module				CO2 FROM ENERGY SOURCES (DETAILED FUELS APPROA					
WORKSHEET				I - 1					
SHEET				B					
				STEP II		STEP III			
				F	G	H	I	J	
				Factor Conversio	Apparent Consumption (GJ)	Factor Emission (kg C/GJ)	Fraction Carbon (kg C)	Fraction Carbon	
Fuels Types					G=(E*F)		I=(G*H)	J=(I*10^-	
	Primary Fuels	Crude Oil				20			
		Gasoline (aviation & motor)		41868	0.00E+00	18.9	0	0.00	
		Kerosene		41868	2.86E+07	19.6	5.61E+08	560.68	
		Jet Fuel		41868	0.00E+00	19.5	0	0.00	
		Residual fuel Oil		41868	0.00E+00	21.1	0	0.00	
Liquid Fossil	Secondary Fuels	LPG		41868	7.82E+06	17.2	1.34E+08	134.45	
		Naphtha		41868	0.00E+00		0	0.00	
		Bitumen		41868	0.00E+00	22	0	0.00	
		Lubricantes		41868	0.00E+00	20	0	0.00	
		Petroleun Coque		41868	0.00E+00	27.5	0	0.00	
		Refinery Gas		41868	0.00E+00	18.2	0	0.00	
		Refinery Feedstocks		41868	0.00E+00		0	0.00	
		Diesel Oil		41868	0.00E+00	20.2	0	0.00	
Liquid Fossil Total					**3.64E+07**		**7E+08**	**695.12**	
		Cooking Coal		41868	3.11E+05	25.8	8025844	8.03	
		Steam Coal		41868	0.00E+00	25.8	0	0.00	
Solid Fossil	Primary Fuels	Lignite		41868	0.00E+00	27.6	0	0.00	
		Sub Bituminous		41868	0.00E+00	26.2	0	0.00	
		Peat		41868	0.00E+00	28.9			
	Secondary Fuels	Coke	Industrial Gas	41868	0.00E+00	15.3	0	0.00	
			Coke	41868	0.00E+00	29.5	0	0.00	
Solid Fossil Total					**3.11E+05**		**8025844**	**8.03**	
Gas Fossil	Primary Fuels	Natural Gas		41868	0.00E+00	15.3	0	0.00	
	Secondary Fuels	Distributed Gas(Gas dry)		41868	1.92E+06	15.2	29210466	29.21	
TOTAL					3.87E+07		7.3E+08	732.36	
		Jet Fuel		41868	0.00E+00	19.5	0	0.00	
Burkers Oils		Diesel Oil		41868	0.00E+00	20.2	0	0.00	
		Residual Fuel Oil		41868	0.00E+00	21.1	0	0.00	
		Aviation Gasoline		41868	0.00E+00	18.9	0	0.00	
		Total Bunkers			**0.00E+00**		**0**	**0.00**	
			Wood	41868	1.16E+08	29.9	3.46E+09	3457.01	
		Solid Biomass	Dung	41868	1.09E+07	29.9	3.25E+08	324.84	
Biomass			Bagasse	41868	0.00E+00	29.9	0	0.00	
			Charcoal	41868	5.19E+06	29.9	1.55E+08	155.10	
		Total Biomass			**1.32E+08**		**3.9E+09**	**3936.95**	

Continuation Table B.6

RESIDENTIAL COMMERCIAL SUBSECTOR

BUTTOM TO UP INVENTORY

Module				ENERGY				
Sub Module				CO2 FROM ENERGY SOURCES (DETAILED FUELS APPRO				
WORKSHEET				I - 1				
SHEET				C				
				STEP IV		STEP V		STEP VI
				K	L	M	N	O
				Carbon Stored (Gg C)	Net Carbon Emission (Gg C)	Fraction Carbon Oxidized (kg C/GJ)	Actual Carbon Emission (Gg C)	Actual CO2 Emission (Gg CO2)
Fuels Types					L=(J-K)		N=(L*M)	O=(N*(44/12)
Liquid Fossil	Primary Fuels	Crude Oil		0.00	0.00	0.990	0.00	0.00
	Secondary Fuels	Gasoline (aviation & motor)		0.00	0.00	0.990	0.00	0.00
		Kerosene		0.00	560.68	0.990	555.07	2035.25
		Jet Fuel		0.00	0.00	0.990	0.00	0.00
		Residual fuel Oil		0.00	0.00	0.990	0.00	0.00
		LPG		0.00	134.45	0.990	133.10	488.05
		Naphtha		0.00	0.00	0.990	0.00	0.00
		Bitumen		0.00	0.00	0.990	0.00	0.00
		Lubricantes		0.00	0.00	0.990	0.00	0.00
		Petroleun Coque		0.00	0.00	0.990	0.00	0.00
		Refinery Gas		0.00	0.00	0.990	0.00	0.00
		Refinery Feedstoscks		0.00	0.00	0.990	0.00	0.00
		Diesel Oil		0.00	0.00	0.990	0.00	0.00
Liquid Fossil Total					**695.12**		**688.17**	**2523.30**
Solid Fossil	Primary Fuels	Cooking Coal		0.00	8.03	0.980	7.87	28.84
		Steam Coal		0.00	0.00	0.980	0.00	0.00
		Lignite		0.00	0.00	0.980	0.00	0.00
		Sub Bituminous		0.00	0.00	0.980	0.00	0.00
		Peat		0.00	0.00	0.980	0.00	0.00
	Secondary Fuels	Coke	Industrial Gas	0.00	0.00	0.995	0.00	0.00
			Coke	0.00	0.00	0.980	0.00	0.00
Solid Fossil Total					**8.03**		**7.87**	**28.84**
Gas Fossil	Primary Fuels	Natural Gas		0.00	0.00	0.995	0.00	0.00
	Secondary Fuels	Distributed Gas(Gas dry)		0.00	29.21	0.995	29.06	106.57
TOTAL					732.36		725.10	2658.71
Burkers Oils		Jet Fuel		0.00	0.00	0.990	0.00	0.00
		Diesel Oil		0.00	0.00	0.990	0.00	0.00
		Residual Fuel Oil		0.00	0.00	0.990	0.00	0.00
		Aviation Gasoline		0.00	0.00	0.990	0.00	0.00
		Total Bunkers			**0.00**		**0.00**	**0.00**
Biomass		Solid Biomass	Wood	0.00	3457.01	0.870	3007.59	11027.85
			Dung	0.00	324.84	0.850	276.12	1012.43
			Bagasse	0.00	0.00	0.880	0.00	0.00
			Charcoal	0.00	155.10	0.880	136.49	500.47
		Total Biomass			**3936.95**		**3420.20**	**12540.75**

Continuation Table B.6

MINING METALLURGY SUBSECTOR

BUTTOM TO UP INVENTORY

Module				ENERGY				
Sub Module				CO2 FROM ENERGY SOURCES (DETAILED FUELS APPRO				
WORKSHEET				I - 1				
SHEET				A				
				STEP 1				
				A	B	C	D	E
				Productio	Imports	Exports	Stock Change	Aparent Consumption
Fuels Types								E=(A+B-C-D)
Liquid Fossil	Primary Fuels	Crude Oil						0.00
	Secondary Fuels	Gasoline (aviation & motor)						11.36
		Kerosene						0.00
		Jet Fuel						4.60
		Residual fuel Oil						271.79
		LPG						2.10
		Naphtha						0.00
		Bitumen						0.00
		Lubricantes						4.62
		Petroleun Coque						0.00
		Refinery Gas						0.00
		Refinery Feedstoscks						0.00
		Diesel Oil						50.50
Liquid Fossil Total								**344.97**
Solid Fossil	Primary Fuels	Cooking Coal						7.85
		Steam Coal						0.00
		Lignite						0.00
		Sub Bituminous						0.00
		Peat						0.00
	Secondary Fuels	Coke	Industrial Ga					0.00
			Coke					26.84
Solid Fossil Total								**34.69**
Gas Fossil	Primary Fuels	Natural Gas						0.00
	Secondary Fuels	Distributed Gas(Gas dry)						0.00
TOTAL								379.66
Burkers Oils		Jet Fuel						0.00
		Diesel Oil						0.00
		Residual Fuel Oil						0.00
		Aviation Gasoline						0.00
		Total Bunkers						**0.00**
Biomass		Solid Biomass	Wood					0.00
			Dung					0.00
			Bagasse					0.00
			Charcoal					0.00
		Total Biomass						**0.00**

Table National CO2 inventory for the Mning-metallurgy subsector

MINING METALLURGY SUBSECTOR

BUTOM TO UP INVENTORY

Module				*ENERGY*				
Sub Module				*CO2 FROM ENERGY SOURCES (DETAILED FUELS APPROA*				
WORKSHEET				*I - 1*				
SHEET				*B*				
				STEP II			*STEP III*	
				F	*G*	*H*	*I*	*J*
				Factor Conversio	*Apparent Consumption (GJ)*	*Factor Emission (kg C/GJ)*	*Fraction Carbon (kg C)*	*Fraction Carbon*
Fuels Types					*G=(E*F)*		*I=(G*H)*	*J=(I*10^-*
Liquid Fossil	*Primary Fuels*	*Crude Oil*				20		
	Secondary Fuels	*Gasoline (aviation & motor)*		*41868*	*4.76E+05*	*18.9*	*8989227*	*8.99*
		Kerosene		*41868*	*0.00E+00*	*19.6*	*0*	*0.00*
		Jet Fuel		*41868*	*1.93E+05*	*19.5*	*3755560*	*3.76*
		Residual fuel Oil		*41868*	*1.14E+07*	*21.1*	*2.4E+08*	*240.11*
		LPG		*41868*	*8.79E+04*	*17.2*	*1512272*	*1.51*
		Naphtha		*41868*	*0.00E+00*	*NA(20.0)*	*0*	*0.00*
		Bitumen		*41868*	*0.00E+00*	*22*	*0*	*0.00*
		Lubricantes		*41868*	*1.93E+05*	*20*	*3868603*	*3.87*
		Petroleun Coque		*41868*	*0.00E+00*	*27.5*	*0*	*0.00*
		Refinery Gas		*41868*	*0.00E+00*	*18.2*	*0*	*0.00*
		Refinery Feedstocks		*41868*	*0.00E+00*	•	*0*	*0.00*
		Diesel Oil		*41868*	*2.11E+06*	*20.2*	*42709547*	*42.71*
Liquid Fossil Total					***1.44E+07***		***3E+08***	***300.94***
Solid Fossil	*Primary Fuels*	*Cooking Coal*		*41868*	*3.29E+05*	*25.8*	*8479526*	*8.48*
		Steam Coal		*41868*	*0.00E+00*	*25.8*	*0*	*0.00*
		Lignite		*41868*	*0.00E+00*	*27.6*	*0*	*0.00*
		Sub Bituminous		*41868*	*0.00E+00*	*26.2*	*0*	*0.00*
		Peat		*41868*	*0.00E+00*	*28.9*		
	Secondary Fuels	*Coke*	*Industrial Gas*	*41868*	*0.00E+00*	*15.3*	*0*	*0.00*
			Coke	*41868*	*1.12E+06*	*29.5*	*33150245*	*33.15*
Solid Fossil Total					***1.45E+06***		***4.2E+07***	***41.63***
Gas Fossil	*Primary Fuels*	*Natural Gas (Dry)*		*41868*	*0.00E+00*	*15.3*	*0*	*0.00*
	Secondary Fuels	*Distributed Gas*		*41868*	*0.00E+00*	*15.2*	*0*	*0.00*
TOTAL					*1.59E+07*		*3.4E+08*	*342.57*
Burkers Oils		*Jet Fuel*		*41868*	*0.00E+00*	*19.5*	*0*	*0.00*
		Diesel Oil		*41868*	*0.00E+00*	*20.2*	*0*	*0.00*
		Residual Fuel Oil		*41868*	*0.00E+00*	*21.1*	*0*	*0.00*
		Aviation Gasoline		*41868*	*0.00E+00*	*18.9*	*0*	*0.00*
		Total Bunkers			***0.00E+00***		***0***	***0.00***
Biomass		*Solid Biomass*	*Wood*	*41868*	*0.00E+00*	*29.9*	*0*	*0.00*
			Dung	*41868*	*0.00E+00*	*29.9*	*0*	*0.00*
			Bagasse	*41868*	*0.00E+00*	*29.9*	*0*	*0.00*
			Charcoal	*41868*	*0.00E+00*	*29.9*	*0*	*0.00*
		Total Biomass			***0.00E+00***	•	***0***	***0.00***

Continuation Table B.7

MINING METALLURGY SUBSECTOR

BUTTOM TO UP INVENTORY

Module				ENERGY				
Sub Module				CO2 FROM ENERGY SOURCES (DETAILED FUELS APPRO				
WORKSHEET				I - 1				
SHEET				C				
				STEP IV		STEP V		STEP VI
				K	L	M	N	O
				Carbon Stored (Gg C)	Net Carbon Emission (Gg C)	Fraction Carbon Oxidized (kg C/GJ)	Actual Carbon Emission (Gg C)	Actual CO2 Emission (Gg CO2)
Fuels Types					L=(J-K)		N=(L*M)	O=(N*(44/12)
Liquid Fossil	Primary Fuels	Crude Oil		0.00	0.00	0.990	0.00	0.00
	Secondary Fuels	Gasoline (aviation & motor)		0.00	8.99	0.990	8.90	32.63
		Kerosene		0.00	0.00	0.990	0.00	0.00
		Jet Fuel		0.00	3.76	0.990	3.72	13.63
		Residual fuel Oil		0.00	240.11	0.990	237.71	871.59
		LPG		0.00	1.51	0.990	1.50	5.49
		Naphtha		0.00	0.00	0.990	0.00	0.00
		Bitumen		0.00	0.00	0.990	0.00	0.00
		Lubricantes		0.00	3.87	0.990	3.83	14.04
		Petroleun Coque		0.00	0.00	0.990	0.00	0.00
		Refinery Gas		0.00	0.00	0.990	0.00	0.00
		Refinery Feedstocks		0.00	0.00	0.990	0.00	0.00
		Diesel Oil		0.00	42.71	0.990	42.28	155.04
Liquid Fossil Total					**300.94**		**297.93**	**1092.42**
Solid Fossil	Primary Fuels	Cooking Coal		0.00	8.48	0.980	8.31	30.47
		Steam Coal		0.00	0.00	0.980	0.00	0.00
		Lignite		0.00	0.00	0.980	0.00	0.00
		Sub Bituminous		0.00	0.00	0.980	0.00	0.00
		Peat		0.00	0.00	0.980	0.00	0.00
	Secondary Fuels	Coke	Industrial Gas	0.00	0.00	0.995	0.00	0.00
			Coke	0.00	33.15	0.980	32.49	119.12
Solid Fossil Total					**41.63**		**40.80**	**149.59**
Gas Fossil	Primary Fuels	Natural Gas (Dry)		0.00	0.00	0.995	0.00	0.00
	Secondary Fuels	Distributed Gas		0.00	0.00	0.995	0.00	0.00
TOTAL					342.57		338.73	1242.01
Burkers Oils		Jet Fuel		0.00	0.00	0.990	0.00	0.00
		Diesel Oil		0.00	0.00	0.990	0.00	0.00
		Residual Fuel Oil		0.00	0.00	0.990	0.00	0.00
		Aviation Gasoline		0.00	0.00	0.990	0.00	0.00
		Total Bunkers			**0.00**		**0.00**	**0.00**
Biomass		Solid Biomass	Wood	0.00	0.00	0.870	0.00	0.00
			Dung	0.00	0.00	0.850	0.00	0.00
			Bagasse	0.00	0.00	0.880	0.00	0.00
			Charcoal	0.00	0.00	0.880	0.00	0.00
		Total Biomass			**0.00**		**0.00**	**0.00**

Continuation Table B.7

FISHING SUBSECTOR

BUTTOM TO UP INVENTORY

Module				ENERGY				
Sub Module				CO2 FROM ENERGY SOURCES (DETAILED FUELS APPRO				
WORKSHEET				I - 1				
SHEET				A				
				STEP 1				
				A	B	C	D	E
				Productio	Imports	Exports	Stock Change	Aparent Consumption
Fuels Types								E=(A+B-C-D)
Liquid Fossil	Primary Fuels	Crude Oil						0.00
	Secondary Fuels	Gasoline (aviation & motor)						0.30
		Kerosene						0.00
		Jet Fuel						0.00
		Residual fuel Oil						165.82
		LPG						0.00
		Naphtha						0.00
		Bitumen						0.00
		Lubricantes						0.07
		Petroleun Coque						0.00
		Refinery Gas						0.00
		Refinery Feedstocks						0.00
		Diesel Oil						39.90
Liquid Fossil Total								**206.09**
Solid Fossil	Primary Fuels	Cooking Coal						0.00
		Steam Coal						0.00
		Lignite						0.00
		Sub Bituminous						0.00
		Peat						0.00
	Secondary Fuels	Coke	Industrial Ga					0.00
			Coke					0.00
Solid Fossil Total								**0.00**
Gas Fossil	Primary Fuels	Natural Gas						0.00
	Secondary Fuels	Distributed Gas(Gas Dry)						0.00
TOTAL								206.09
Burkers Oils		Jet Fuel						0.00
		Diesel Oil						0.00
		Residual Fuel Oil						0.00
		Aviation Gasoline						0.00
		Total Bunkers						**0.00**
Biomass		Solid Biomass	Wood					0.00
			Dung					0.00
			Bagasse					0.00
			Charcoal					0.00
		Total Biomass						**0.00**

Table B.8 National CO2 Inventory for the fishing subsector

FISHING SUBSECTOR

BUTOM TO UP INVENTORY

Module				ENERGY				
Sub Module				CO2 FROM ENERGY SOURCES (DETAILED FUELS APPROA				
WORKSHEET				I - 1				
SHEET				B				
				STEP II		STEP III		
				F	G	H	I	J
				Factor Conversio	Apparent Consumption (GJ)	Factor Emission (kg C/GJ)	Fraction Carbon (kg C)	Fraction Carbon
Fuels Types					G=(E*F)		I=(G*H)	J=(I*10^-
Liquid Fossil	Primary Fuels	Crude Oil				20		
	Secondary Fuels	Gasoline (aviation & motor)		41868	1.26E+04	18.9	237391.6	0.24
		Kerosene		41868	0.00E+00	19.6	0	0.00
		Jet Fuel		41868	0.00E+00	19.5	0	0.00
		Residual fuel Oil		41868	6.94E+06	21.1	1.46E+08	146.49
		LPG		41868	0.00E+00	17.2	0	0.00
		Naphtha		41868	0.00E+00		0	0.00
		Bitumen		41868	0.00E+00	22	0	0.00
		Lubricantes		41868	2.93E+03	20	58615.2	0.06
		Petroleun Coque		41868	0.00E+00	27.5	0	0.00
		Refinery Gas		41868	0.00E+00	18.2	0	0.00
		Refinery Feedstocks		41868	0.00E+00		0	0.00
		Diesel Oil		41868	1.67E+06	20.2	33744771	33.74
Liquid Fossil Total					8.63E+06		1.8E+08	180.53
Solid Fossil	Primary Fuels	Cooking Coal		41868	0.00E+00	25.8	0	0.00
		Steam Coal		41868	0.00E+00	25.8	0	0.00
		Lignite		41868	0.00E+00	27.6	0	0.00
		Sub Bituminous		41868	0.00E+00	26.2	0	0.00
		Peat		41868	0.00E+00	28.9		
	Secondary Fuels	Coke	Industrial Gas	41868	0.00E+00	15.3	0	0.00
			Coke	41868	0.00E+00	29.5	0	0.00
Solid Fossil Total					0.00E+00		0	0.00
Gas Fossil	Primary Fuels	Natural Gas (Dry)		41868	0.00E+00	15.3	0	0.00
	Secondary Fuels	Distributed Gas		41868	0.00E+00	15.2	0	0.00
TOTAL					8.63E+06		1.8E+08	180.53
Burkers Oils		Jet Fuel		41868	0.00E+00	19.5	0	0.00
		Diesel Oil		41868	0.00E+00	20.2	0	0.00
		Residual Fuel Oil		41868	0.00E+00	21.1	0	0.00
		Aviation Gasoline		41868	0.00E+00	18.9	0	0.00
		Total Bunkers			0.00E+00		0	0.00
Biomass		Solid Biomass	Wood	41868	0.00E+00	29.9	0	0.00
			Dung	41868	0.00E+00	29.9	0	0.00
			Bagasse	41868	0.00E+00	29.9	0	0.00
			Charcoal	41868	0.00E+00	29.9	0	0.00
		Total Biomass			0.00E+00		0	0.00

Continuation Table B.8

FISHING SUBSECTOR

BUTTOM TO UP INVENTORY

Module				*ENERGY*				
Sub Module				*CO2 FROM ENERGY SOURCES (DETAI ED FUE S APPRO*				
WORLSHEET				*I - 1*				
SHEET				C				
				STEP IV		*STEP V*		*STEP VI*
				L		*M*	*N*	*O*
				Carbon Stored (Gg C)	*Net Carbon Emission (Gg C)*	*Fraction Carbon Oxidized (kg C/GJ)*	*Actual Carbon Emission (Gg C)*	*Actual CO2 Emission (Gg CO2)*
Fuels Types					*=(J-L)*		*N=(*M)*	*O=(N*(44/12)*
iquid Fossil	*Primary Fuels*	*Crude Oil*		0.00	0.00	0.990	0.00	0.00
	Secondary Fuels	*Gasoline (aviation & motor)*		0.00	0.24	0.990	0.24	0.86
		Lerosene		0.00	0.00	0.990	0.00	0.00
		Jet Fuel		0.00	0.00	0.990	0.00	0.00
		Residual fuel Oil		0.00	146.49	0.990	145.02	531.75
		PG		0.00	0.00	0.990	0.00	0.00
		Naphtha		0.00	0.00	0.990	0.00	0.00
		Bitumen		0.00	0.00	0.990	0.00	0.00
		ubricantes		0.00	0.06	0.990	0.06	0.21
		Petroleun Coque		0.00	0.00	0.990	0.00	0.00
		Refinery Gas		0.00	0.00	0.990	0.00	0.00
		Refinery Feedstoscks		0.00	0.00	0.990	0.00	0.00
		Diesel Oil		0.00	33.74	0.990	33.41	122.49
Liquid Fossil Total					180.53		178.72	655.32
Solid Fossil	*Primary Fuels*	*Cooking Coal*		0.00	0.00	0.980	0.00	0.00
		Steam Coal		0.00	0.00	0.980	0.00	0.00
		ignite		0.00	0.00	0.980	0.00	0.00
		Sub Bituminous		0.00	0.00	0.980	0.00	0.00
		Peat		0.00	0.00	0.980	0.00	0.00
	Secondary Fuels	*Coke*	*Industrial Gas*	0.00	0.00	0.995	0.00	0.00
			Coke	0.00	0.00	0.980	0.00	0.00
Solid Fossil Total					0.00		0.00	0.00
Gas Fossil	*Primary Fuels*	*Natural Gas (Dry)*		0.00	0.00	0.995	0.00	0.00
	Secondary Fuels	*Distributed Gas*		0.00	0.00	0.995	0.00	0.00
TOTAL					180.53		178.72	655.32
Burkers Oils		*Jet Fuel*		0.00	0.00	0.990	0.00	0.00
		Diesel Oil		0.00	0.00	0.990	0.00	0.00
		Residual Fuel Oil		0.00	0.00	0.990	0.00	0.00
		Aviation Gasoline		0.00	0.00	0.990	0.00	0.00
		Total Bunkers			0.00		0.00	0.00
Biomass		*Solid Biomass*	*Wood*	0.00	0.00	0.870	0.00	0.00
			Dung	0.00	0.00	0.850	0.00	0.00
			Bagasse	0.00	0.00	0.880	0.00	0.00
			Charcoal	0.00	0.00	0.880	0.00	0.00
		Total Biomass			0.00		0.00	0.00

Continuation Table B.8

PUBLIC SERVICE SUBSECTOR

BUTTOM TO UP INVENTORY

Module				ENERGY				
Sub Module				CO2 FROM ENERGY SOURCES (DETAILED FUELS APPRO				
WORKSHEET				I - 1				
SHEET				A				
				STEP 1				
				A	B	C	D	E
				Productio	Imports	Exports	Stock Change	Aparent Consumption
Fuels Types								E=(A+B-C-D)
Liquid Fossil	Primary Fuels	Crude Oil						0.00
	Secondary Fuels	Gasoline (aviation & motor)						73.80
		Kerosene						5.46
		Jet Fuel						55.28
		Residual fuel Oil						22.63
		LPG						0.00
		Naphtha						0.00
		Bitumen						0.00
		Lubricantes						1.55
		Petroleum Coque						0.00
		Refinery Gas						0.00
		Refinery Feedstocks						0.00
		Diesel Oil						125.70
Liquid Fossil Total								**284.42**
Solid Fossil	Primary Fuels	Cooking Coal						0.00
		Steam Coal						0.00
		Lignite						0.00
		Sub Bituminous						0.00
		Peat						0.00
	Secondary Fuels	Coke	Industrial Ga					0.00
			Coke					0.00
Solid Fossil Total								**0.00**
Gas Fossil	Primary Fuels	Natural Gas						0.00
	Secondary Fuels	Distributed Gas(Gas dry)						0.00
TOTAL								284.42
Burkers Oils		Jet Fuel						0.00
		Diesel Oil						0.00
		Residual Fuel Oil						0.00
		Aviation Gasoline						0.00
		Total Bunkers						**0.00**
Biomass		Solid Biomass	Wood					0.00
			Dung					0.00
			Bagasse					0.00
			Charcoal					0.00
		Total Biomass						**0.00**

Table B.9 National CO2 Inventory for the Public Service subsector

PUBLIC SERVICE SUBSECTOR

BUTOM TO UP INVENTORY

Module				ENERGY					
Sub Module				CO2 FROM ENERGY SOURCES (DETAILED FUELS APPROA					
WORKSHEET				I - 1					
SHEET						B			
				STEP II			STEP III		
				F	G	H	I	J
				Factor Conversio	Apparent Consumption (GJ)	Factor Emission (kg C/GJ)	Fraction Carbon (kg C)	Fraction Carbon
Fuels Types					G=(E*F)		I=(G*H)	J=(I*10^-
Liquid Fossil	Primary Fuels	Crude Oil				20		
	Secondary Fuels	Gasoline (aviation & motor)		41868	3.09E+06	18.9	58398324	58.40
		Kerosene		41868	2.29E+05	19.6	4480546	4.48
		Jet Fuel		41868	2.31E+06	19.5	45132029	45.13
		Residual fuel Oil		41868	9.47E+05	21.1	19991677	19.99
		LPG		41868	0.00E+00	17.2	0	0.00
		Naphtha		41868	0.00E+00		0	0.00
		Bitumen		41868	0.00E+00	22	0	0.00
		Lubricantes		41868	6.49E+04	20	1297908	1.30
		Petroleun Coque		41868	0.00E+00	27.5	0	0.00
		Refinery Gas		41868	0.00E+00	18.2	0	0.00
		Refinery Feedstocks		41868	0.00E+00		0	0.00
		Diesel Oil		41868	5.26E+06	20.2	1.06E+08	106.31
Liquid Fossil Total					**1.19E+07**		**2.4E+08**	**235.61**
Solid Fossil	Primary Fuels	Cooking Coal		41868	0.00E+00	25.8	0	0.00
		Steam Coal		41868	0.00E+00	25.8	0	0.00
		Lignite		41868	0.00E+00	27.6	0	0.00
		Sub Bituminous		41868	0.00E+00	26.2	0	0.00
		Peat		41868	0.00E+00	28.9		
	Secondary Fuels	Coke	Industrial Gas	41868	0.00E+00	15.3	0	0.00
			Coke	41868	0.00E+00	29.5	0	0.00
Solid Fossil Total					**0.00E+00**		**0**	**0.00**
Gas Fossil	Primary Fuels	Natural Gas		41868	0.00E+00	15.3	0	0.00
	Secondary Fuels	Distributed Gas(Gas dry)		41868	0.00E+00	15.2	0	0.00
TOTAL					1.19E+07		2.4E+08	235.61
Burkers Oils		Jet Fuel		41868	0.00E+00	19.5	0	0.00
		Diesel Oil		41868	0.00E+00	20.2	0	0.00
		Residual Fuel Oil		41868	0.00E+00	21.1	0	0.00
		Aviation Gasoline		41868	0.00E+00	18.9	0	0.00
		Total Bunkers			**0.00E+00**		**0**	**0.00**
Biomass		Solid Biomass	Wood	41868	0.00E+00	29.9	0	0.00
			Dung	41868	0.00E+00	29.9	0	0.00
			Bagasse	41868	0.00E+00	29.9	0	0.00
			Charcoal	41868	0.00E+00	29.9	0	0.00
		Total Biomass			**0.00E+00**		**0**	**0.00**

Continuation of Table B.9

PUBLIC SERVICE SUBSECTOR

BUTTOM TO UP INVENTORY

Module				ENERGY				
Sub Module				CO2 FROM ENERGY SOURCES (DETAILED FUELS APPRO				
WORKSHEET				I - 1				
SHEET				C				
				STEP IV		STEP V		STEP VI
				K	L	M	N	O
				Carbon Stored (Gg C)	Net Carbon Emission (Gg C)	Fraction Carbon Oxidized (kg C/GJ)	Actual Carbon Emission (Gg C)	Actual CO2 Emission (Gg CO2)
Fuels Types					L=(J-K)		N=(L*M)	O=(N*(44/12)
Liquid Fossil	Primary Fuels	Crude Oil		0.00	0.00	0.990	0.00	0.00
	Secondary Fuels	Gasoline (aviation & motor)		0.00	58.40	0.990	57.81	211.99
		Kerosene		0.00	4.48	0.990	4.44	16.26
		Jet Fuel		0.00	45.13	0.990	44.68	163.83
		Residual fuel Oil		0.00	19.99	0.990	19.79	72.57
		LPG		0.00	0.00	0.990	0.00	0.00
		Naphtha		0.00	0.00	0.990	0.00	0.00
		Bitumen		0.00	0.00	0.990	0.00	0.00
		Lubricantes		0.00	1.30	0.990	1.28	4.71
		Petroleun Coque		0.00	0.00	0.990	0.00	0.00
		Refinery Gas		0.00	0.00	0.990	0.00	0.00
		Refinery Feedstoscks		0.00	0.00	0.990	0.00	0.00
		Diesel Oil		0.00	106.31	0.990	105.25	385.90
Liquid Fossil Total					**235.61**		**233.25**	**855.26**
Solid Fossil	Primary Fuels	Cooking Coal		0.00	0.00	0.980	0.00	0.00
		Steam Coal		0.00	0.00	0.980	0.00	0.00
		Lignite		0.00	0.00	0.980	0.00	0.00
		Sub Bituminous		0.00	0.00	0.980	0.00	0.00
		Peat		0.00	0.00	0.980	0.00	0.00
	Secondary Fuels	Coke	Industrial Gas	0.00	0.00	0.995	0.00	0.00
			Coke	0.00	0.00	0.980	0.00	0.00
Solid Fossil Total					**0.00**		**0.00**	**0.00**
Gas Fossil	Primary Fuels	Natural Gas		0.00	0.00	0.995	0.00	0.00
	Secondary Fuels	Distributed Gas(Gas dry)		0.00	0.00	0.995	0.00	0.00
TOTAL					235.61		233.25	855.26
Burkers Oils		Jet Fuel		0.00	0.00	0.990	0.00	0.00
		Diesel Oil		0.00	0.00	0.990	0.00	0.00
		Residual Fuel Oil		0.00	0.00	0.990	0.00	0.00
		Aviation Gasoline		0.00	0.00	0.990	0.00	0.00
		Total Bunkers			**0.00**		**0.00**	**0.00**
Biomass		Solid Biomass	Wood	0.00	0.00	0.870	0.00	0.00
			Dung	0.00	0.00	0.850	0.00	0.00
			Bagasse	0.00	0.00	0.880	0.00	0.00
			Charcoal	0.00	0.00	0.880	0.00	0.00
		Total Biomass			**0.00**		**0.00**	**0.00**

Continuation of Table B.9

AGRICULTURE AND CATTLE-AGRICULTURAL INDUSTRY SUBSECTOR

BUTTOM TO UP INVENTORY

Module				ENERGY				
Sub Module				CO2 FROM ENERGY SOURCES (DETAILED FUELS APPR				
WORKSHEET				I - 1				
SHEET				A				
				STEP I				
				A	B	C	D	E
				Productio	Imports	Exports	Stock Change	Aparent Consumption
Fuels Types								E=(A+B-C-D)
Liquid Fossil	Primary Fuels	Crude Oil						0.00
	Secondary Fuels	Gasoline (aviation & motor)						2.60
		Kerosene						0.11
		Jet Fuel						0.09
		Residual fuel Oil						67.91
		LPG						0.00
		Naphtha						0.00
		Bitumen						0.00
		Lubricantes						0.07
		Petroleun Coque						0.00
		Refinery Gas						0.00
		Refinery Feedstoscks						0.00
		Diesel Oil						18.60
Liquid Fossil Total								89.38
Solid Fossil	Primary Fuels	Cooking Coal						0.00
		Steam Coal						0.00
		Lignite						0.00
		Sub Bituminous						0.00
		Peat						0.00
	Secondary Fuels	Coke	Industrial Ga					0.00
			Coke					0.00
Solid Fossil Total								0.00
Gas Fossil	Primary Fuels	Natural Gas (Dry)						0.00
	Secondary Fuels	Distributed Gas						0.00
TOTAL								89.38
Burkers Oils		Jet Fuel						0.00
		Diesel Oil						0.00
		Residual Fuel Oil						0.00
		Aviation Gasoline						0.00
		Total Bunkers						0.00
Biomass		Solid Biomass	Wood					0.00
			Dung					0.00
			Bagasse					122.84
			Charcoal					0.00
		Total Biomass						122.84

Table B.10 National CO2 inventory for the Agriculture and cattle -Agricultural industry subsector

AGRICULTURE AND CATTLE-AGRICULTURAL INDUSTRY SUBSECTOR

BUTOM TO UP INVENTORY

Module				ENERGY				
Sub Module				CO2 FROM ENERGY SOURCES (DETAILED FUELS APPROA				
WORKSHEET				I - 1				
SHEET				B				
				STEP II		STEP III		
				F	G	H	I	J
				Factor Conversio	Apparent Consumption (GJ)	Factor Emission (kg C/GJ)	Fraction Carbon (kg C)	Fraction Carbon
Fuels Types					G=(E*F)		I=(G*H)	J=(I*10^-
Liquid Fossil	Primary Fuels	Crude Oil				20		
	Secondary Fuels	Gasoline (aviation & motor)		41868	1.09E+05	18.9	2057394	2.06
		Kerosene		41868	4.61E+03	19.6	90267.41	0.09
		Jet Fuel		41868	3.77E+03	19.5	73478.34	0.07
		Residual fuel Oil		41868	2.84E+06	21.1	59992699	59.99
		LPG		41868	0.00E+00	17.2	0	0.00
		Naphtha		41868	0.00E+00		0	0.00
		Bitumen		41868	0.00E+00	22	0	0.00
		Lubricantes		41868	2.93E+03	20	58615.2	0.06
		Petroleun Coque		41868	0.00E+00	27.5	0	0.00
		Refinery Gas		41868	0.00E+00	18.2	0	0.00
		Refinery Feedstocks		41868	0.00E+00		0	0.00
		Diesel Oil		41868	7.79E+05	20.2	15730645	15.73
Liquid Fossil Total					**3.74E+06**		**7.8E+07**	**78.00**
Solid Fossil	Primary Fuels	Cooking Coal		41868	0.00E+00	25.8	0	0.00
		Steam Coal		41868	0.00E+00	25.8	0	0.00
		Lignite		41868	0.00E+00	27.6	0	0.00
		Sub Bituminous		41868	0.00E+00	26.2	0	0.00
		Peat		41868	0.00E+00	28.9		
	Secondary Fuels	Coke	Industrial Gas	41868	0.00E+00	15.3	0	0.00
			Coke	41868	0.00E+00	29.5	0	0.00
Solid Fossil Total					**0.00E+00**		**0**	**0.00**
Gas Fossil	Primary Fuels	Natural Gas (Dry)		41868	0.00E+00	15.3	0	0.00
	Secondary Fuels	Distributed Gas		41868	0.00E+00	15.2	0	0.00
TOTAL					3.74E+06		7.8E+07	78.00
Burkers Oils		Jet Fuel		41868	0.00E+00	19.5	0	0.00
		Diesel Oil		41868	0.00E+00	20.2	0	0.00
		Residual Fuel Oil		41868	0.00E+00	21.1	0	0.00
		Aviation Gasoline		41868	0.00E+00	18.9	0	0.00
		Total Bunkers			**0.00E+00**		**0**	**0.00**
Biomass		Solid Biomass	Wood	41868	0.00E+00	29.9	0	0.00
			Dung	41868	0.00E+00	29.9	0	0.00
			Bagasse	41868	5.14E+06	29.9	1.54E+08	153.78
			Charcoal	41868	0.00E+00	29.9	0	0.00
		Total Biomass			**5.14E+06**		**1.5E+08**	**153.78**

Continuation of Table B.10

AGRICULTURE AND CATTLE-AGRICULTURAL INDUSTRY SUBSECTOR

BUTTOM TO UP INVENTORY

Module				ENERGY				
Sub Module				CO2 FROM ENERGY SOURCES (DETAILED FUELS APPRO				
WORKSHEET				I - 1				
SHEET				C				
				STEP IV		STEP V		STEP VI
				K	L	M	N	O
				Carbon Stored (Gg C)	Net Carbon Emission (Gg C)	Fraction Carbon Oxidized (kg C/GJ)	Actual Carbon Emission (Gg C)	Actual CO2 Emission (Gg CO2)
Fuels Types					L=(J-K)		N=(L*M)	O=(N*(44/12)
Liquid Fossil	Primary Fuels	Crude Oil		0.00	0.00	0.990	0.00	0.00
	Secondary Fuels	Gasoline (aviation & motor)		0.00	2.06	0.990	2.04	7.47
		Kerosene		0.00	0.09	0.990	0.09	0.33
		Jet Fuel		0.00	0.07	0.990	0.07	0.27
		Residual fuel Oil		0.00	59.99	0.990	59.39	217.77
		LPG		0.00	0.00	0.990	0.00	0.00
		Naphtha		0.00	0.00	0.990	0.00	0.00
		Bitumen		0.00	0.00	0.990	0.00	0.00
		Lubricantes		0.00	0.06	0.990	0.06	0.21
		Petroleun Coque		0.00	0.00	0.990	0.00	0.00
		Refinery Gas		0.00	0.00	0.990	0.00	0.00
		Refinery Feedstoscks		0.00	0.00	0.990	0.00	0.00
		Diesel Oil		0.00	15.73	0.990	15.57	57.10
Liquid Fossil Total					**78.00**		**77.22**	**283.15**
Solid Fossil	Primary Fuels	Cooking Coal		0.00	0.00	0.980	0.00	0.00
		Steam Coal		0.00	0.00	0.980	0.00	0.00
		Lignite		0.00	0.00	0.980	0.00	0.00
		Sub Bituminous		0.00	0.00	0.980	0.00	0.00
		Peat		0.00	0.00	0.980	0.00	0.00
	Secondary Fuels	Coke	Industrial Gas	0.00	0.00	0.995	0.00	0.00
			Coke	0.00	0.00	0.980	0.00	0.00
Solid Fossil Total					**0.00**		**0.00**	**0.00**
Gas Fossil	Primary Fuels	Natural Gas (Dry)		0.00	0.00	0.995	0.00	0.00
	Secondary Fuels	Distributed Gas		0.00	0.00	0.995	0.00	0.00
TOTAL					78.00		77.22	283.15
Burkers Oils		Jet Fuel		0.00	0.00	0.990	0.00	0.00
		Diesel Oil		0.00	0.00	0.990	0.00	0.00
		Residual Fuel Oil		0.00	0.00	0.990	0.00	0.00
		Aviation Gasoline		0.00	0.00	0.990	0.00	0.00
		Total Bunkers			**0.00**		**0.00**	**0.00**
Biomass		Solid Biomass	Wood	0.00	0.00	0.870	0.00	0.00
			Dung	0.00	0.00	0.850	0.00	0.00
			Bagasse	0.00	153.78	0.880	135.32	496.19
			Charcoal	0.00	0.00	0.880	0.00	0.00
		Total Biomass			**153.78**		**135.32**	**496.19**

Continuation of Table B.10

APPENDIX C

C.1 This appendix present detailed estimates of the CO_2, CH_4, and N_2O emissions for the Non Energy Sector.

Table C.1 shows CO_2 emissions from Industrial processes activities

Table C.2 shows CH_4 emissions due to Animals and animal manure.

Table C.3 shows CH_4 emissions due to rice cultivation.

Table C.4 shows Gases emissions different to CO_2 due to savanna burning.

Table C.5 shows Gases emissions different to CO_2 due to Agricultural Residuals Burning.

Table C.6 shows N_2O emission due to the use of Nitrous Fertilizers.

Table C.7 shows CO_2 emissions due to clearing of Forest.

Table C.8 shows CO_2 emissions due to Burning of the Clearing forest.

Table C.9 shows CO_2 emissions due to the Conversion of grasslands into cultivated lands.

Table C.10 shows CO_2 absortion due to Abandoned Cultivated land

Table C.11 shows CO_2 absortion due to Forest management.

Table C.12 shows CH_4 emissions from landfills.

Table C.13 shows CH_4 emisions from open dumping.

Table C.14 shows CH_4 emissions from municipal wastewater.

Table C.15 shows CH_4 emissions from Industrial wastewater.

EMISSION FROM INDUSTRIAL PROCESSES ACTIVITIES

MODULE	INDUSTRIAL PROCESSES		
SUBMODULE	EMISSIONS CO2		
WORKSHEET	2-1		
SHEET	I		
INDUSTRIAL PROCESSES	PRODUCTION (Tonnes)	EF	CO2 EMISSIONS Gg
CEMENT	2185000	0.4985	1089.22
		TOTAL	1089.22

Table C.1 CO2 emissions from industrial processes activities

AGRICULTURE AND CATTLE AREA : Animal and animal manure

		MODULE	AGRICULTURE AND CATTLE			
		SUBMODULE	METHANE EMISSIONS FROM ANIMALS AND ANIMAL MANURE, AVERAGE (89,90,9			
		WORKSHEET	4-1			
		SHEET	A			
	A	B	C	D	E	F
Livestock Type	Number of Animal (1000)	Emissions Factor for Enteric Fermentation (Kg/head/year)	Emissions from Enteric Fermentation (Mg/year)	Emissions Factor for Manure Management (Kg/head/year)	Emissions from Manure Management (Mg/year)	Total Emissions from Animals and Manure (Gg)
			C=(AxB)		E=(AxD)	F=(C+E)/1000
Dairy Cattle	597.116	57.0	34035.612	0.6583514	393.112	34.429
Other Cattle	4125.880	49.0	202168.120	1.0000000	4125.880	206.294
Alpaca	2713.151	10.0	27131.510	0.7000000	1899.206	29.031
Sheep	12484.293	5.0	62421.465	0.1232548	1538.749	63.960
Goats	1746.598	5.0	8732.990	0.1514680	264.554	8.998
Llamas	1056.615	10.0	10566.150	0.8000000	845.292	11.411
Horses	660.000	18.0	11880.000	1.6000000	1056.000	12.936
Mules & Donkey	710.000	10.0	7100.000	0.9000000	639.000	7.739
Swine	2416.964	1.0	2416.964	1.8227262	4405.464	6.822
Poultry	62405.742			0.0179503	1120.202	1.120
		Totals	366452.811		16287.458	382.740

Table C.2 CH4 emission due to animals and animal manure

AGRICULTURE AND CATTLE AREA : Rice cultivation

		MODULE	AGRICULTURE AND CATTLE				
		SUB MODULE	METHANE EMISSIONS FROM RICE CULTIVATIONS				
		WORKSHEET	4-2				
		SHEET	A				
Department	Water Management Regime	Growing Season Average Temperature (T°C)	A Harvested Area (Mha)	B Season Length (days)	C Megahectare-Days (Mha-day)	D Emissions Factor (kg/ha-days)	E CH4 Emissions by Irrigation Regime (Gg)
					C=(AxB)		E=(CxD)
TUMBES	Inundated	26	0.006754	150	1.0131	5.56	5.63
PIURA	Inundated	24	0.021457	150	3.21855	4.94	15.90
LAMBAYEQUE	Inundated	22	0.022830	150	3.4245	4.39	15.03
LA LIBERTAD	Inundated	21	0.025712	150	3.8568	4.14	15.97
CAJAMARCA	Inundated	18	0.016013	150	2.40195	3.48	8.36
AMAZONAS	Inundated	19	0.017185	150	2.57775	3.68	9.49
ANCASH	Inundated	23	0.001385	150	0.20775	4.66	0.97
HUANUCO	Inundated	20	0.000845	150	0.12675	3.91	0.50
PASCO	Inundated	17	0.001400	150	0.21	3.28	0.69
JUNIN	Inundated	17	0.000764	150	0.1146	3.28	0.38
AREQUIPA	Inundated	20	0.014071	150	2.11065	3.91	8.25
AYACUCHO	Inundated	16	0.000685	150	0.10275	3.09	0.32
CUZCO	Inundated	19	0.001375	150	0.20625	3.68	0.76
PUNO	Inundated	16	0.000210	150	0.0315	3.09	0.10
MADRE DE DIOS	Inundated	25	0.004841	150	0.72615	5.24	3.81
SAN MARTIN	Inundated	27	0.026450	150	3.9675	5.90	23.41
LORETO	Inundated	27	0.018046	150	2.7069	5.90	15.97
UCAYALI	Inundated	25	0.005450	150	0.8175	5.24	4.28
TOTALS			0.185473				129.80

Table C.3 CH4 emissions due to rice cultivation

AGRICULTURE AND CATTLE AREA : Savanna burning

MODULE				AGRICULTURE			
SUBMODULE				SAVANNA BURNING, RELEASE OF NON-CO2 TRACE GASES			
WORKSHEET				4-3			
SHEET				A			
STEP 1					STEP 2		
A Area Burning by Category (K ha) (specify)	B Biomass Density of Savanna (t dm/ha)	C Total Biomass Exposed to Burning (kt dm)	D Fraction Actually Burned	E Quantity Actually Burned (kt dm)	F Fraction of Living Biomass Burned	G Quantity of Living Biomass Burned (kt dm)	H Quantity of Dead Biomass Burned (kt dm)
		C=(AxB)		E=(CxD)		G=(ExF)	H=(E-G)
15205.5	6.6	100356.3	0.8	80285.04	0.45	36128.268	44156.772

Table C.4 Other gases emission due to savanna burning diferent of CO2

AGRICULTURE AND CATTLE AREA : Savanna burni

MODULE	AGRICULTURE		
SUBMODULE	SAVANNA BURNING, RELEASE OF NON-CO2 TRACE GASES		
WORKSHEET	4-3		
SHEET	B		
STEP 3			
I Fraction Oxidised (Combustion Efficiency) of living and dead biomass	J Total Biomass Oxidized (kt dm)	K Carbon Fraction of Living & Dead Biomass	L Total Carbon Released (kt C)
	living = J=(GxI) dead = J=(HxI)		L=(JxK)
0.8	28902.61	0.45	13006.176
1.0	44156.77	0.40	17662.709
		TOTAL	30668.885

Continuation of Table C.4

AGRICULTURE AND CATTLE AREA : Savanna burning

MODULE	AGRICULTURE					
SUBMODULE	SAVANNA BURNING, RELEASE OF NON-CO2 TRACE GASES					
WORKSHEET	4-3					
SHEET	A					
STEP 4					STEP 5	
L Total Carbon Released (Kt C)	M Nitrogen-Carbon Ratio	N Total Nitrogen Content (Kt N)	O Emissions Ratio	P Trace Gas Emissions (Kt C or Kt N)	Q Conversion Factors	R Trace Gas Emissions from Savanna Burning
				P=(LxO)		R=(PxQ)
30668.88			0.004	122.676	16/12	163.567 Gg CH4
30668.88			0.06	1840.133	28/12	4293.643 Gg CO
				P=(NxO)		R=(PxQ)
30668.88	0.006	184.013	0.007	1.288	44/28	2.024 Gg N2O
30668.88	0.006	184.013	0.012	2.208	30/14	4.732 Gg NOx

Continuation of Table C.4

AGRICULTURE AND CATTLE AREA : Agricultural residues

			MODULE	AGRICULTURE								
			SUB MODULE	BURNING OF AGRICULTURAL RESIDUES, RELEASE OF NON-CO2 TRACE GASES								
			WORKSHEET	4-4								
			SHEET	A					B			
	STEP 1			STEP 2		STEP 3			STEP 4		STEP 5	
Crops	A	B	C	D	E	F	G	H	I	J	K	L
(specify locally important crops)	Annual Production Average (Kt crop)	Residue to Crop Ratio	Quantity of Residue (Kt biomass)	Dry Matter Content	Quantity of Dry Residue (Kt dm)	Fraction Burned in Fields	Fraction of Bio-mass which Oxidized (com-bustion efficiency)	Total Biomass Burned (Kt dm)	Carbon Fraction Residue	Total Carbon Released (Kt C)	Nitrogen-Carbon Ratio	Total Nitrogen Released (Kt N)
			C=(AxB)		E=(CxD)			H=(ExFxG)		J=(HxI)		L=(JxK)
Cotton	245.61	7.53	1849.45	0.60	1109.67	1.00	0.90	998.7034	0.4500	449.417	0.015	6.741
Sugar Cane	6024.78	0.20	1204.96	0.40	481.98	1.00	0.90	433.7838	0.4072	176.637	0.015	2.650
Rice	957.23	1.40	1340.13	0.80	1072.10	0.10	0.90	96.4891	0.4144	39.985	0.014	0.560
Asparagus	54.85	2.80	153.59	0.70	107.51	0.70	0.90	67.7337	0.4500	30.480	0.015	0.457
Corn	771.29	1.00	771.29	0.40	308.52	0.10	0.90	27.7665	0.4709	13.075	0.020	0.262
Potato	1431.62	0.40	572.65	0.50	286.32	0.05	0.90	12.8846	0.4226	5.445	0.015	0.082
Wheat	128.89	1.30	167.55	0.80	134.04	0.05	0.90	6.0319	0.4853	2.927	0.012	0.035
Barley	104.15	1.20	124.98	0.80	99.99	0.05	0.90	4.4995	0.4567	2.055	0.015	0.031
Bean	49.51	1.50	74.26	0.40	29.70	0.10	0.90	2.6734	0.4500	1.203	0.015	0.018
Total										721.22		10.83

Table C.5 Gases emission due Agricultural Residulas Burning.

AGRICULTURE AND CATTLE AREA : Agricultural residues

MODULE	AGRICULTURE		
SUB MODULE	BURNING OF AGRICULTURAL RESIDUES, RELEASE OF NON-CO2 TRACE GASES		
WORKSHEET	4-4		
SHEET	D		
STEP 6			
M Emissions Ratio	N Trace Gas Emissions (Kt C or Kt N)	O Conversion Factors	P Trace Gas Emissions from Field Burning of Agricultural Residues
	N=(JxM)		P=(NxO)
0.005	3.606	16/12	4.81 Gg CH4
0.06	43.273	28/12	100.97 Gg CO
	N=(LxM)		P=(NxO)
0.007	0.076	44/28	0.12 Gg N2O
0.121	1.311	46/14	4.31 Gg NOx

Continuation of Table C.5

AGRICULTURE AND CATTLE AREA : Use of nitrous fertilizers

MODULE	AGRICULTURE AND CATTLE							
SUB MODULE	NITROGENOUS FERTILIZERS USE							
WORKSHEET	4-5							
SHEET	A							
Fertilizer Type	A % Nitrogen	B Average Amount Consumed (Tonnes)	C Average Amount of Nitrogen (Tonnes)	D Emissions Coefficient	E N2O Emissions (Tonnes N2O-N)	F Conversion Factor	G N2O Emissions (Tonnes-N2O)	H N2O Emissions (Gg N2O)
			C=(AxB)		E=(CxD)		G=(ExF)	H=G/1000
BAYOMIX	11.0	1584	174.24	0.01	1.742	44/28	2.74	0.003
DIAMMONIUM PHOSPHATE	21.0	16268	3416.28	0.01	34.163	44/28	53.68	0.054
ISLAND MANURE 9-11-2	9.0	3832	344.88	0.01	3.449	44/28	5.42	0.005
AMMONIUM NITRATE	33.5	35539	11905.57	0.01	119.056	44/28	187.09	0.187
AMMONIUM SUFPHATE	21.0	8628	1811.88	0.01	18.119	44/28	28.47	0.028
UREA	46.0	101016	46467.36	0.01	464.674	44/28	730.20	0.730
COMPOUND MANURE 12-12-12	12.0	2455	294.60	0.01	2.946	44/28	4.63	0.005
TOTALS		169322			644.148		1012.23	1.012

Table C.6 N2O emission due to use of Nitrous Fertilizers.

LAND USE CHANGE AND FORESTRY AREA

			MODULE	LAND USE CHANGE AND FORESTRY								
			SUB MODULE	FOREST CLEARING - CO2 RELEASE FROM DECAY OF ABOVE GROUND BIOMASS								
			WORKSHEET	5-1								
			SHEET	D								
				STEP 5								
Forest types				A Annual Area Cleared (10 Year Average) (Kha)	B Biomass Before Clearing (t dm/ha)	C Biomass After Clearing (t dm/ha)	D Net Change in Biomass (t dm/ha)	E Average Annual Loss of Biomass (Kt dm)	F Fraction Left to Decay	G Quantity of Biomass to Decay (Kt dm)	H Carbon Fraction in Aboveground Biomass	I Portion C Released as CO2 (Kt C)
							D=(B-C)	E=(AxD)		G=(ExF)		I=(GxH)
Tropical	Closed Forests	Broadleaf	Undisturbed	193	275.2	10	265.2	51183.6	0.02	1023.67	0.45	460.65

Continuation of Table C.7

LAND USE CHANGE AND FORESTRY AREA

MODULE		LAND USE CHANGE AND FORESTRY				
SUB MODULE		FOREST CLEARING - SOIL CARBON RELEASE				
WORKSHEET		5-1				
SHEET		E				
		STEP 6				
		A Average Annual Forest Clearing (25 year average) (Kha)	B Soil Carbon Content of Forest Soil (t/ha)	C Total Annual Potential Soil Carbon Loss (Kt C)	D Fraction of Carbon Relesed	E Carbon Release from Soil Carbon (Kt C)
				C=AxB		E=(CxD)
Tropical						
Temperate	Evergreen	130	115	14950	0.5	7475
	Deciduous					
Boreal						
					Total	7475

Continuation of Table C.7

LAND USE CHANGE AND FORESTRY AREA

	MODULE	LAND USE CHANGE AND FORESTRY		
	SUB MODULE	FOREST CLEARING- TOTAL CO2 EMISSIONS		
	WORKSHEET	5-1		
	SHEET	F		
		STEP 7		
A	B	C	D	E
Immediate Release From Burning (Kt C)	Delayed emmisions From Decay (Kt C)	Long term emission from Soil (Kt C)	Total annual Carbon Release from forest Clearing (Kt C)	Total annual CO2 release Forest Clearing (Gg CO2)
			D= A+B+C	E=D*(44/12)
25549.63	460.65	74.75	35485.28	1300112.69

Continuation of Table C.7

LAND USE CHANGE AND FORESTRY AREA

		MODULE	LAND USE CHANGE AND FORESTRY				
		SUB MODULE	ON-SITE BURNING OF CLEARED FORESTS				
		WORKSHEET	5-2				
		SHEET	A				
STEP 1			STEP 2				
A 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 Factors	G Trace Gas Emissions from Burning of Cleared Forests Kt CH4 CO
(From column K of Worksheet 5.1 B)					E=(AxD)		G=(ExF)
27549.63	0.01	275.50	CH4	0.012	330.60	16/12	440.79
			CO	0.1	2754.96	28/12	6428.25
					Kt N		Kt N2O, NOx
		C=(AxB)			E=(CxD)		G=(ExF)
			N2O	0.007	1.93	44/28	3.03
			NOx	0.121	33.34	30/14	71.43

Table C.8 CO_2 emissions due to Clearing forest

LAND USE CHANGE AND FORESTRY AREA

		MODULE	LAND USE CHANGE AND FORESTRY	
		SUB MODULE	CO2 EMISSIONS FROM CONVERSION OF GRASSLAND TO CULTIVATED LANDS	
		WORKSHEET	5-3	
		SHEET	A	
1	2	3	4	5
A 25 Year Total Conversion of Grassland to Cultivation (kha)	B Soil Carbon Content of Grassland (t C/ha)	C Annual Rate of Carbon Release from Soil	D Total Annual Soil Carbon Release From Grassland Conversion (kt C)	E Total CO2 Released from Historic Conversion Over 25 year (kt CO2)
			D=(AxBxC)	E=(Dx[44/12])
696	60	0.02	835.2	3062.4

Table C.9 CO_2 emission due to conversion of grassland into cultivated land

LAND USE CHANGE AND FORESTRY AREA

MODULE	LAND USE CHANGE AND FORESTRY		
SUB MODULE	ABANDONMENT OF MANAGED LANDS		
WORKSHEET	5-4		
SHEET	A		

STEP 1

Regrowth Land Type		A 20 Year Total Area Abandoned (Kha)	B Annual Rate of Above-ground Biomass Uptake (t dm/ha)	C Annual Aboveground Boimass Uptake (Kt dm)	D Carbon Content of Aboveground Biomass	E Annual Carbon Uptake in Aboveground Biomass (Kt C)
				C=(AxB)		E=(CxD)
Tropical Forests	Closed Broadleaf	2080	8	16640	0.45	7488

Table C.10 CO2 absortion due to abandoned cultivated land

LAND USE CHANGE AND FORESTRY AREA

MODULE	LAND USE CHANGE AND FORESTRY					
SUB MODULE	ABANDONMENT OF MANAGED LANDS					
WORKSHEET	5-4					
SHEET	B					
STEP 2				STEP 3		
F	G	H	I	J	K	L
Annual Rate of Uptake of Carbon in Soils (t C/ha)	Total Annual Carbon Uptake in Soils (Kt C)	Total Area Abandoned More than Twenty Years (Kha)	Annual Rate of Above-ground Biomass Uptake (t dm/ha)	Annual Above-ground Biomass Uptake (Kt dm/ha)	Carbon Content of Above-ground Biomass	Annual Carbon Uptake in Above-ground Biomass (Kt C)
	G=(AxF)			J=(HxI)		L=(JxK)
1.3	2704	3720	0.9	3348	0.45	1506.6

Continuation of table C.10

LAND USE CHANGE AND FORESTRY AREA

MODULE	LAND USE CHANGE AND FORESTRY		
SUB MODULE	ABANDONMENT OF MANAGED LANDS		
WORKSHEET	5-4		
SHEET	C		
STEP 4	STEP 5		
M	N	O	P
Annual Rate of Uptake of Carbon in Soils	Total Annual Carbon Uptake in Soils	Total Carbon Uptake from Abandoned Lands	Total Carbon Dioxide Uptake
(t C/ha)	(Kt C)	(Kt C)	(Kt CO2)
	N=(HxM)	O=(E+G+L+N)	P=(Ox[44/12])
0.5	1860	13558.6	49714.87

Continuation of table C.10

LAND USE CHANGE AND FORESTRY AREA

	MODULE	LAND USE CHANGE AND FORESTRY				
	SUB MODULE	MANAGED FORESTS				
	WORKSHEET	5-5				
	SHEET	A				
		STEP 1				
		A Area of Managed Forest (Kha)	B Annual Growth Rate (t dm/ha)	C Annual Biomass Increment (Kt dm)	D Carbon Content of Dry Master	E Total Carbon Increment (Kt C)
				C=(AxB)		
Tropical	Plantations	263	13.5	3550.5	0.45	1597.73

Table C.11 CO2 Absortion due to Forest management

LAND USE CHANGE AND FORESTRY AREA

MODULE	LAND USE CHANGE AND FORESTRY							
SUB MODULE	MANAGED FORESTS							
WORKSHEET	5-5							
SHEET	B							
	STEP 2							
	F	G	H	I	J	K	L	M
Harvest Categories (specify)	Commercial Harvest	Biomass Expansion Factor	Total Biomass Removed in Commercial Harvest	Total Traditional Fuelwood Consumed	Other Wood Use	Total Biomass Con-sumption	Wood Renoved From Forest Clearing	Totla Biomass Consump-tion From Managed Forests
	(Km3 roundwood)	t dm/m3	(Kt dm)	(Kt dm)	(Kt dm)	(Kt dm)	(Kt dm)	(Kt dm)
			H=(FxG)	(From column H, Worksheet I-2)		K=(H+I+J)	(From column M, Worksheet 5-I)	M=K-L
	122.86	2.5	307.15	5192.8		5499.95	2148.12	3351.83

Continuation of Table C.11

LAND USE CHANGE AND FORESTRY AREA

MODULE	LAND USE CHANGE AND FORESTRY		
SUB MODULE	MANAGED FORESTS		
WORKSHEET	5-5		
SHEET	C		
	STEP 3		
N	O	P	Q
Carbon Fraction	Annual Carbon Release (Kt C)	Annual Absorption or release (Kt C)	Convert to CO2 Annual Emission or Removal (Gg CO2)
	O=(MxN)	P=(E-O)	Q=(Px[44/12])
0.45	1508.32	89.40	327.81

Continuation of Table C.11

WASTE AREA : Landfills

		MODULE	WASTE		
		SUB MODULO	METHANE EMISSIONS FROM LANDFILLS		
		WORKSHEET	6-I (SUPPLEMENTAL)		
		SHEET	A		
	A	B	C	D	E
REGION AND DEPARTAMENT	Urban Population (10^6 persons)	Waste Generation Rate (Gg MSW/10 (persons/year)	Waste Generate (Gg MSW)	Fraction Landfilled	MSW Landfilled (Gg MSW)
			C=(AxB)		E=(CxD)
LIMA	4.344623	193.45	840.47	0.35	294.16
CALLAO	0.609482	193.45	117.90	0.35	41.27
LA LIBERTAD	0.821557	116.8	95.96	0.42	40.30
TOTALES	5.775662		1054.33		375.73

Table C.12 CH4 Emission from landfills

		MODULE	WASTE						
		SUBMODULE	METHANE EMISSION FROM LANDFILS						
		WORKSHEET	6-1						
		SHEET	A						
	A	B	C	D	E	F	G	H	I
REGION AND DEPARTAMENT	Annual MSW Landfilled (Gg MSW)	Fraction of DOC (Gg DOC/Gg MS	Annual DOC Landfilled (Gg)	Fraction Which Actually Degrades	Annual Carbon Released as Biogas (Gg)	Fraction CH4 (Gg C-CH4/ Gg C-Biogas)	CH4-C Emission (Gg C)	Conversion Factor (16/12)	CH4 Emission (Gg CH4)
			C=(AxB)		E=(CxD)		G=(ExF)		I=(GxH)
LIMA	294.16	0.15	44.12	0.77	33.98	0.5	16.99	1.33	22.65
CALLAO	41.27	0.15	6.19	0.77	4.77	0.5	2.38	1.33	3.18
LA LIBERTAD	40.30	0.15	6.04	0.77	4.65	0.5	2.33	1.33	3.10
TOTALES	375.73		56.36		43.40		21.70		28.93

Continuation of Table C.12

WASTE AREA : Open dumpind

		MODULE	WASTE		
		SUB MODULO	METHANE EMISSIONS FROM OPEN DUM		
		WORKSHEET	6-I (SUPPLEMENTAL)		
		SHEET	A		
	A	B	C	D	E
REGION AND DEPARTAMENT	Urban Population (10 ^ 6 persons)	Waste Generation Rate (Gg MSW/10 ^ 6 (persons/year)	Waste Generate (Gg MSW)	Fraction Landfilled	MSW Landfilled (Gg MSW)
			C = (AxB)		E = (CxD)
LIMA	4.344623	193.45	840.47	0.65	546.30
CALLAO	0.609482	193.45	117.90	0.65	76.64
LA LIBERTAD	0.821557	116.8	95.96	0.58	55.66
PIURA	0.961753	222.65	214.13	0.8	171.31
TUMBES	0.122291	182.5	22.32	0.8	17.85
AMAZONAS	0.111461	135.05	15.05	0.8	12.04
CAJAMARCA	0.292543	135.05	39.51	0.8	31.61
LAMBAYEQUE	0.667877	200.75	134.08	0.8	107.26
LORETO	0.365917	109.5	40.07	0.8	32.05
SAN MARTIN	0.315703	375.95	118.69	0.8	94.95
ANCASH	0.509552	219	111.59	0.8	89.27
HUANUCO	0.230394	146	33.64	0.8	26.91
JUNIN	0.768744	87.6	67.34	0.8	53.87
PASCO	0.130631	197.1	25.75	0.8	20.60
UCAYALI	0.208312	365	76.03	0.8	60.83
AYACUCHO	0.227550	222.65	50.66	0.8	40.53
HUANCAVELICA	0.768744	93.95	72.22	0.8	57.78
ICA	0.442170	153.3	67.78	0.8	54.23
APURIMAC	0.081379	156.95	12.77	0.8	10.22
CUZCO	0.387513	255.5	99.01	0.8	79.21
MADRE DE DIOS	0.035189	32.85	1.16	0.8	0.92
AREQUIPA	0.739644	127.75	94.49	0.8	75.59
PUNO	0.351996	255.5	89.93	0.8	71.95
MOQUEGUA	0.100159	76.65	7.68	0.8	6.14
TACNA	0.210628	164.25	34.60	0.8	27.68
TOTALES	13.805812		2482.84		1821.40

Table C.13 Methane emission from open dumping

MSW : Municipal solid waste
DOC : Degrade organic carbon

WASTE AREA : Open dumpind

		MODULE	WASTE						
		SUB MODULE	METHANE EMISSIONS FROM OPEN DUMPING						
		WORKSHEET	6-1						
		SHEET	A						
	A	B	C	D	E	F	G	H	I
REGION AND DEPARTAMENT	Annual MSW Landfilled (Gg MSW)	Fraction of DOC (Gg DOC/Gg M	Annual DO Landfilled (Gg)	Fraction Which Actually Degrades	Annual Carbon Released a Biogas (Gg)	Fraction CH4 (Gg C-CH4 Gg C-Biog	CH4-C Emission (Gg C)	Conversio Factor (16/12)	CH4 Emission (Gg CH4)
			C=(AxB)		E=(CxD)		G=(ExF)		I=(GxH)/2
LIMA	546.30	0.15	81.95	0.77	63.10	0.5	31.55	1.33	21.03
CALLAO	76.64	0.15	11.50	0.77	8.85	0.5	4.43	1.33	2.95
LA LIBERTAD	55.66	0.15	8.35	0.77	6.43	0.5	3.21	1.33	2.14
PIURA	171.31	0.15	25.70	0.77	19.79	0.5	9.89	1.33	6.60
TUMBES	17.85	0.15	2.68	0.77	2.06	0.5	1.03	1.33	0.69
AMAZONAS	12.04	0.15	1.81	0.77	1.39	0.5	0.70	1.33	0.46
CAJAMARCA	31.61	0.15	4.74	0.77	3.65	0.5	1.83	1.33	1.22
LAMBAYEQUE	107.26	0.15	16.09	0.77	12.39	0.5	6.19	1.33	4.13
LORETO	32.05	0.15	4.81	0.77	3.70	0.5	1.85	1.33	1.23
SAN MARTIN	94.95	0.15	14.24	0.77	10.97	0.5	5.48	1.33	3.66
ANCASH	89.27	0.15	13.39	0.77	10.31	0.5	5.16	1.33	3.44
HUANUCO	26.91	0.15	4.04	0.77	3.11	0.5	1.55	1.33	1.04
JUNIN	53.87	0.15	8.08	0.77	6.22	0.5	3.11	1.33	2.07
PASCO	20.60	0.15	3.09	0.77	2.38	0.5	1.19	1.33	0.79
UCAYALI	60.83	0.15	9.12	0.77	7.03	0.5	3.51	1.33	2.34
AYACUCHO	40.53	0.15	6.08	0.77	4.68	0.5	2.34	1.33	1.56
HUANCAVELICA	57.78	0.15	8.67	0.77	6.67	0.5	3.34	1.33	2.22
ICA	54.23	0.15	8.13	0.77	6.26	0.5	3.13	1.33	2.09
APURIMAC	10.22	0.15	1.53	0.77	1.18	0.5	0.59	1.33	0.39
CUZCO	79.21	0.15	11.88	0.77	9.15	0.5	4.57	1.33	3.05
MADRE DE DIOS	0.92	0.15	0.14	0.77	0.11	0.5	0.05	1.33	0.04
AREQUIPA	75.59	0.15	11.34	0.77	8.73	0.5	4.37	1.33	2.91
PUNO	71.95	0.15	10.79	0.77	8.31	0.5	4.15	1.33	2.77
MOQUEGUA	6.14	0.15	0.92	0.77	0.71	0.5	0.35	1.33	0.24
TACNA	27.68	0.15	4.15	0.77	3.20	0.5	1.60	1.33	1.07
TOTALES	1821.40		273.21		210.37		105.19		70.12

Continuation of Table C.13

WASTE AREA : Municipal wastewater

		MODULE	DESPERDICIOS				
		SUB MODULE	METHANE EMISSIONS FROM MUNICIPAL WASTEWATER				
		WORKSHEET	6-2				
		SHEET	1				
	A	B	C	D	E	F	G
Region and Department	Population (Specify sub-categories if any) (1000 persons)	Wastewater BOD Generation Rate (Gg BOD5/ 1000 persons/year)	BOD Generated (Gg BOD5)	Fraction Anaerobically Treated (Gg BOD5)	Quantity of BOD Treated Anaerobically (Gg BOD5)	Methane Emissions Factor (Gg CH4/ Kg BOD5)	CH4 Emissions (Gg CH4)
			C=(AxB)		Bw=(CxD)		Ge=(ExF)
GRAU							
Piura	961.753	0.0146	14.04	0.1	1.40	0.22	0.31
Tumbes	122.291	0.0146	1.79	0.1	0.18	0.22	0.04
NOR-ORIENTAL DEL MARAÑON			0.00				
Amazonas	111.461	0.0146	1.63	0.1	0.16	0.22	0.04
Cajamarca	292.543	0.0146	4.27	0.1	0.43	0.22	0.09
Lambayeque	667.877	0.0146	9.75	0.1	0.98	0.22	0.21
LORETO			0.00				
Loreto	365.917	0.0146	5.34	0.1	0.53	0.22	0.12
SAN MARTIN-LA LIBERTAD			0.00				
La Libertad	821.557	0.0146	11.99	0.1	1.20	0.22	0.26
San Martin	315.703	0.0146	4.61	0.1	0.46	0.22	0.10
CHAVIN			0.00				
Ancash	509.552	0.0146	7.44	0.1	0.74	0.22	0.16
ANDRES AVELINO CACERES			0.00				
Huánuco	230.394	0.0146	3.36	0.1	0.34	0.22	0.07
Junin	768.744	0.0146	11.22	0.1	1.12	0.22	0.25
Pasco	130.631	0.0146	1.91	0.1	0.19	0.22	0.04
UCAYALI			0.00				
Ucayali	208.312	0.0146	3.04	0.1	0.30	0.22	0.07
LOS LIBERTADORES-WARI			0.00				
Ayacucho	227.550	0.0146	3.32	0.1	0.33	0.22	0.07
Huancavelica	768.744	0.0146	11.22	0.1	1.12	0.22	0.25
Ica	442.170	0.0146	6.46	0.1	0.65	0.22	0.14
INCA			0.00				
Apurimac	81.379	0.0146	1.19	0.1	0.12	0.22	0.03
Cusco	387.513	0.0146	5.66	0.1	0.57	0.22	0.12
Madre de Dios	35.189	0.0146	0.51	0.1	0.05	0.22	0.01
AREQUIPA			0.00				
Arequipa	739.644	0.0146	10.80	0.1	1.08	0.22	0.24
JOSE CARLOS MARIATEGUI			0.00				
Puno	351.996	0.0146	5.14	0.1	0.51	0.22	0.11
Moquegua	100.159	0.0146	1.46	0.1	0.15	0.22	0.03
Tacna	210.628	0.0146	3.08	0.1	0.31	0.22	0.07
LIMA							
Lima	4344.623	0.0146	63.43	0.1	6.34	0.22	1.40
Callao	600.101	0.0146	8.76	0.1	0.88	0.22	0.19
TOTALS	13796.431		201.43		20.14		4.43

Table C.14 CH4 emission from municipal wastewater

WASTE AREA : Industrial wastewater

MODULE	WASTE		
SUB MODULE	METHANE EMISSIONS FROM INDUSTRIAL WASTEWATER		
WORKSHEET	6-3 (SUPPLEMENTAL)		
SHEET	A		
INDUSTRY	Water Consumption (liters/Tonnes)	Industrial Production (Tonnes)	Annual Wastewater Outflow (M litres)
	A	B	C=(AxB)
IRON AND STEEL	50000 [46]	99305	4965.25
FOOD			
Green Beans	80000 [2]	35865	2869.20
Peaches & pears	22000 [2]	1188	26.14
Beer	15000 [47]	568524 mlt	8527.86
Meat packing	180000 [45]	3573 cab.	643.14
Dairy products	17000 [47]	155961	2651.34
Sugar	33500 [48]	586492	19647.48
Fish processing	17000 [2]	1601200	27220.40
Oil & grease	4250 [2]	191998	815.99
Coffee	21700 [2]	81000	1757.70
Soft Drinks	250000 [47]	268251 mlt	67062.75
Grain	500 [2]	48.6	0.02
Cereals	500 [2]	17103	8.55
PULP & PAPER	170000 [45]	86675	14734.75
PETROLEUM REFINIG (PETROCHEMICALS)	680 [45]	47050000 barril	31994.00
TEXTILS			
Bleaching	350000 [2]	239000	83650.00
Dying	60000 [2]	239000	14340.00
TANNERY	65000 [45]	4130911	268509.22
RUBBER	6500 [48]	971830	6316.90
CHEMICAL PRODUCTS			
Rayon	300000 [45]	1125	337.50
TOTALS			556078.18

Table C.15 Methane emission from Industrial wastewater.

WASTE AREA : Industrial wastewater

MODULE	WASTE						
SUB MODULE	METHANE EMISSIONS FROM INDUSTRIAL WASTEWATER						
WORKSHEET	6-3						
SHEET	A						
INDUSTRY	A Annual Wastewater Outflow M litres	B BOD Concentration Kg/litre	C Total BOD Generated (Gg BOD)	D Fraction of Wastewater Treated Anaerobically	E Quantity of BOD From anaerobically Treated wastewater Gg BOD	F Methane Emission factor Gg CH4/ Gg BOD5	G Total Methane Realeased Gg CH4
			C=(A*B)		E=(CxD)		G=(ExF)
IRON AND STEEL	4985.25	0.001 [2]	4.97	0.1	0.50	0.22	0.11
FOOD							
Green Beans	2869.20	0.003 [2]	8.61	0.1	0.86	0.22	0.19
Peaches & pears	28.14	0.003 [2]	0.08	0.1	0.01	0.22	0.002
Beer	8527.86	0.0018 [43]	15.35	0.1	1.54	0.22	0.34
Meat packing	643.14	0.0017 [44]	1.09	0.1	0.11	0.22	0.02
Dairy products	2551.34	0.005 [45]	13.26	0.1	1.33	0.22	0.29
Sugar	19647.48	0.002 [2]	39.29	0.1	3.93	0.22	0.86
Fish processing	27220.40	0.0027 [43]	73.50	0.1	7.35	0.22	1.62
Oil & grease	815.99	0.019 [2]	15.50	0.1	1.55	0.22	0.34
Coffee	1757.70	0.0015 [2]	2.64	0.1	0.26	0.22	0.06
Soft Drinks	67062.75	0.0016 [43]	107.30	0.1	10.73	0.22	2.36
Grain	0.02	0.003 [2]	0.0001	0.1	0.00001	0.22	0.000002
Cereals	8.55	0.001 [2]	0.01	0.1	0.001	0.22	0.0002
PULP & PAPER	14734.75	0.004 [2]	58.94	0.1	5.89	0.22	1.30
PETROLEUM REFINIG (PETROCHEMICALS)	31994.00	0.004 [2]	127.98	0.1	12.80	0.22	2.82
TEXTILS							
Bleaching	83650.00	0.001 [2]	83.85	0.1	8.37	0.22	1.84
Dying	14340.00	0.001 [2]	14.34	0.1	1.43	0.22	0.32
TANNERY	268509.22	0.0024 [43]	644.42	0.1	64.44	0.22	14.18
RUBBER	6316.90	0.001 [2]	6.32	0.1	0.63	0.22	0.14
CHEMICAL PRODUCTS							
Rayon	337.50	0.0002 [45]	0.07	0.1	0.01	0.22	0.001
TOTALS	556078.18		1217.30		121.73		26.78

Continuation of the Table C.15

APPENDIX D

D.1 This appendix present detailed estimates of the CH_4 and N_2O inventories according to the IPCC methodology for 1990.

Table D.1 shows the CH_4 National Inventory for the extraction of charcoal.

Table D.2 shows National CH_4 Inventory for natural gas ands oil activities.

Table D.3 shows the National CH_4 and N_2O Inventories for the Conversion Activity (process)

Table D.4 shows the National CH_4 and N_2O inventories for the Conversion activity (Electricity generation).

Table D.5 shows the National CH_4 and N_2O Inventories for the Industrial Sector.

Table D.6 shows the National CH_4 and N_2O Inventories for the Residential/ Commercial Sector.

Table D.7 shows the National CH_4 and N_2O Inventories for the Agropecuarian-Agroindustrial Sector.

ESTIMATING METHANE EMISSIONS FROM COAL MINING AND HANDLING

MODULE		ENERGY				
SUBMODULE		METHANE EMISSIONS FROM MINING AND HANDLING				
WORKSHEET		I-4				
SHEET		1 OF 1				
		STEP 1			STEP 2	
		A Amount of Coal Produced (Million t)	B Emission Factor (m^3 CH4/t)	C Methane Emissions (Million m^3)	D Conversion Fatcors (0.67 Gg CH4/10^6 m^3)	E Methane Emissions (Gg CH4)
				C=(AxB)		E=(CxD)
Underground	Mining	0.1002	25.00	2.51	0.67	1.68
Mines	Post-Minig	0.1002	4.00	0.40	0.67	0.27
Surface	Mining	0.0000	2.00	0.00	0.67	0.00
Mines	Post-Minig	0.0000	0.20	0.00	0.67	0.00
					Total	1.95

Table D.1 CH4 National inventory for the extraction of coal

FUGITIVE METHANE EMISSIONS FROM OIL AND NATURAL GAS ACTIVITIES

MODULE	ENERGY			
SUBMODULE	METHANE EMISSIONS FROM OIL AND GAS ACTIVITIES (TIER I APRO			
WORKSHEET	I-5			
SHEET	1 OF 1			
STEP 1				
	A	B	C	E
Category	Activity (PJ)	Emission Factor (*)	CH4 Emissions (kg CH4)	Methane Emissions CH4 (Gg CH4)
OIL			C=(AxB)	D=(C/10^6)
Production	271.84	5000	1359215.31	1.36
Transport	311.15	745	231807.37	0.23
Refining	311.15	745	231807.37	0.23
Storage	311.15	250	77787.71	0.08
			TOTAL CH4 FROM OIL	1.90
GAS				
Production	31.71	96000	3043997.87	3.04
Processing	21.47	288000	6183695.93	6.18
Transmission and Dist.(a)	20.80	118000	2454254.43	2.45
Power Station (b)	3.14	175000	550176.92	0.55
Industrial Plants (c)	1.19	175000	208083.96	0.21
Residential & Commer.(d	1.92	43500	83595.74	0.08
			TOTAL CH4 FROM GAS	12.52
VENTING AND FLARING FROM GAS PROUCTION	31.71	192000	6087995.74	6.09
			TOTAL CH4 EMISSIONS FROM OIL AND GAS	20.51

(a). Considered total gas consumed.
(b). Leakage at power stations
(c). Leakage at Industrial activities. Emission factor of 118000kg/pJ of gas consumed is used only f
(d). Leakage at residential and commercial sectors.
(*). Emission factors are average value (high-low)

Table D.2 CH4 National inventory for natural gas and oil activities

ESTIMATING CARBON CONTENT OF BIOMASS FUELS, CARBON RELEASED AND METHANE EMISSIONS
CONVERSION (POROCESS)

MODULE	ENERGY							
SUBMODULE	TRADITIONAL BIOMASS BURNED FOR ENERGY							
WORKSHEET	I-3							
SHEET	I OF 3							
	STEP 1				STEP 2		STEP 3	
	A Biomass Consumed (kt dm)	B Carbon Fraction of Biomass	C Carbon Content (kt dm)	D Fraction Oxidised	E Total Carbon Released by Biomass Fuel (kt C)	F C-CH4 Ratio	G Carbon Emitted as CH4 (kt C)	H CH4 Emissio from biomas Burned (Gg CH4)
			C=(AxB)		E=(CxD)		G=(ExF)	H=(G[16/12]
Wood	0.00	0.50	0.00	0.87	0.00	0.015	0.00	0.00
Agriculture Wastes	0.00	0.48	0.00	0.88	0.00	0.007	0.00	0.00
Dung	0.00	0.42	0.00	0.85	0.00	0.017	0.00	0.00
Charcoal Consumption	0.00	0.87	0.00	0.88	0.00	0.0014	0.00	0.00
Charcoal Production					582.61	0.090	52.44	69.91
				Total	582.61		52.44	69.91
Charcoal Production								
Input(Wood)	860.25	0.87	748.42		748.42			
Output(Charcoal)	190.58	0.87	165.80		165.80			
Carbon Released					582.61			

Conversion Factor : Wood (0.360 ktoe/kt)
Bagasse (0.150 ktoe/kt)
Dung (0.350 ktoe/kt)
Charcoal (0.650 ktoe/kt)

kt : kilotonnes
dm : dry matter

ESTIMATING EMISSIONS OF CARBON MONOXIDE AND NITROUS OXIDE
CONVERSION (POROCESS)

MODULE	ENERGY							
SUBMODULE	TRADITIONAL BIOMASS BURNED FOR ENERGY							
WORKSHEET	I-3							
SHEET	2 OF 3							
	STEP 4				STEP 5			
	I C-CO Trace Gas Emission Ratio	J C Emitted CO (kt C) (a)	K CO Emitted (Gg CO)	L Nitrogen-Carbon Fuel Ratio	M Total Nitrogen Released (kt N) (a)	N N-N2O Trace Gas Emissions Ratio	O Nitrogen Emitted as N2O (kt N)	P N2O Emitted (Gg N2O)
		J=(ExI)	k=(J*28/12)		M=(ExL)		O=(MxN)	P=(Ox44/28)
Wood	0.08	0.00	0.00	0.01	0.00	0.009	0.00	0.00
Agriculture Wastes	0.08	0.00	0.00	0.02	0.00	0.009	0.00	0.00
Dung	0.08	0.00	0.00	?		0.009		
Charcoal Consumption	0.08	0.00	0.00	?		0.009		
Charcoal Production	0.08	46.61	108.75	?		0.009		
		Total	108.75					0.00

(a). Data from Worksheet I-3 Sheet I of 3 (column E), Anex ...

Table D.3 CH4 and N2O National Inventories for the Conversion activity

ESTIMATING CARBON CONTENT OF BIOMASS FUELS, CARBON RELEASED AND METHANE EMISSIONS
ELECTRIC UTILITIES

MODULE	ENERGY
SUBMODULE	TRADITIONAL BIOMASS BURNED FOR ENERGY
WORKSHEET	I-3
SHEET	I OF 3

	STEP 1				STEP 2		STEP 3	
	A Biomass Consumed (kt dm)	B Carbon Fraction of Biomass	C Carbon Content (kt dm)	D Fraction Oxidised	E Total Carbon Released by Biomass Fuels (kt C)	F C-CH4 Ratio	G Carbon Emitted as CH4 (kt C)	H CH4 Emissio from biomas Burned (Gg CH4)
			C=(AxB)		E=(CxD)		G=(ExF)	H=(G[16/12]
Wood	0.00	0.50	0.00	0.87	0.00	0.015	0.00	0.00
Agriculture Wastes	302.67	0.48	145.28	0.88	127.85	0.007	0.89	1.19
Dung	0.00	0.42	0.00	0.85	0.00	0.017	0.00	0.00
Charcoal Consumption	0.00	0.87	0.00	0.88	0.00	0.0014	0.00	0.00
Charcoal Production					0.00	0.090	0.00	0.00
				Total	127.85		0.89	1.19
Charcoal Production								
Input(Wood)	0.00	0.87	0.00		0.00			
Output(Charcoal)	0.00	0.87	0.00		0.00			
Carbon Released					0.00			

Conversion Factor : Wood (0.360 ktoe/kt)
Bagasse (0.150 ktoe/kt)
Dung (0.350 ktoe/kt)
Charcoal (0.650 ktoe/kt)

kt : kilotonnes
dm : dry matter

ESTIMATING EMISSIONS OF CARBON MONOXIDE AND NITROUS OXIDE
ELECTRIC UTILITIES

MODULE	ENERGY
SUBMODULE	TRADITIONAL BIOMASS BURNED FOR ENERGY
WORKSHEET	I-3
SHEET	2 OF 3

	STEP 4			STEP 5				
	I C-CO Trace Gas Emission Ratio	J C Emitted CO (kt C) (a)	K CO Emitted (Gg CO)	L Nitrogen-Carbon Fuel Ratio	M Total Nitrogen Released (kt N) (a)	N N-N2O Trace Gas Emissions Ratio	O Nitrogen Emitted as N2O (kt N)	P N2O Emitted (Gg N2O)
		J=(ExI)	k=(J*28/12)		M=(ExL)		O=(MxN)	P=(Ox44/28)
Wood	0.08	0.00	0.00	0.01	0.00	0.009	0.00	0.00
Agriculture Wastes	0.08	10.23	23.86	0.02	2.56	0.009	0.02	0.04
Dung	0.08	0.00	0.00	?		0.009		
Charcoal Consumption	0.08	0.00	0.00	?		0.009		
Charcoal Production	0.08	0.00	0.00	?		0.009		
		Total	23.86					0.04

(a). Data from Worksheet I-3 Sheet I of 3 (column E), Anex ...

Table D.4 CH4 and N2O National inventories for the conversion activity (electricity generation)

ESTIMATING CARBON CONTENT OF BIOMASS FUELS, CARBON RELEASED AND METHANE EMISSIONS
INDUSTRIAL SECTOR

MODULE	ENERGY
SUBMODULE	TRADITIONAL BIOMASS BURNED FOR ENERGY
WORKSHEET	I-3
SHEET	I OF 3

	STEP 1				STEP 2		STEP 3	
444.6108	A Biomass Consumed (kt dm)	B Carbon Fraction of Biomass	C Carbon Content (kt dm)	D Fraction Oxidised	E Total Carbon Released by Biomass Fuels (kt C)	F C-CH4 Ratio	G Carbon Emitted as CH4 (kt C)	H CH4 Emissio from biomass Burned (Gg CH4)
			C=(AxB)		E=(CxD)		G=(ExF)	H=(G(16/12))
Wood	1235.03	0.50	617.51	0.87	537.24	0.015	8.06	10.74
Agriculture Wastes	0.00	0.48	0.00	0.88	0.00	0.007	0.00	0.00
Dung	0.00	0.42	0.00	0.85	0.00	0.017	0.00	0.00
Charcoal Consumption	0.00	0.87	0.00	0.88	0.00	0.0014	0.00	0.00
Charcoal Production					0.00	0.090	0.00	0.00
				Total	537.24		8.06	10.74
Charcoal Production								
Input(Wood)	0.00	0.87	0.00		0.00			
Output(Charcoal)	0.00	0.87	0.00		0.00			
Carbon Released					0.00			

Conversion Factor : Wood (0.360 ktoe/kt)
Bagasse (0.150 ktoe/kt)
Dung (0.350 ktoe/kt)
Charcoal (0.650 ktoe/kt)

kt : kilotonnes
dm : dry matter

ESTIMATING EMISSIONS OF CARBON MONOXIDE AND NITROUS OXIDE
INDUSTRIAL SECTOR

MODULE	ENERGY
SUBMODULE	TRADITIONAL BIOMASS BURNED FOR ENERGY
WORKSHEET	I-3
SHEET	2 OF 3

	STEP 4			STEP 5				
	I C-CO Trace Gas Emission Ratio	J C Emitted CO (kt C) (a)	K CO Emitted (Gg CO)	L Nitrogen-Carbon Fuel Ratio	M Total Nitrogen Released (kt N) (a)	N N-N2O Trace Gas Emissions Ratio	O Nitrogen Emitted as N2O (kt N)	P N2O Emitted (Gg N2O)
		J=(ExI)	k=(J*28/12)		M=(ExL)		O=(MxN)	P=(Ox44/28)
Wood	0.08	42.98	100.28	0.01	5.37	0.009	0.05	0.08
Agriculture Wastes	0.08	0.00	0.00	0.02	0.00	0.009	0.00	0.00
Dung	0.08	0.00	0.00	?		0.009		
Charcoal Consumption	0.08	0.00	0.00	?		0.009		
Charcoal Production	0.08	0.00	0.00	?		0.009		
		Total	100.28					0.08

(a). Data from Worksheet I-3 Sheet I of 3 (column E), Anex ...

Table D.5 CH4 and N2O National inventories for the industrial sector.

ESTIMATING CARBON CONTENT OF BIOMASS FUELS, CARBON RELEASED AND METHANE EMISSIONS

RESIDENTIAL AND COMMERCIAL SECTOR

MODULE	ENERGY							
SUBMODULE	TRADITIONAL BIOMASS BURNED FOR ENERGY							
WORKSHEET	I-3							
SHEET	1 OF 3							
	STEP 1				STEP 2		STEP 3	
	A Biomass Consumed (kt dm)	B Carbon Fraction of Biomass	C Carbon Content (kt dm)	D Fraction Oxidised	E Total Carbon Released by Biomass Fuels (kt C)	F C-CH4 Ratio	G Carbon Emitted as CH4 (kt C)	H CH4 Emissio from biomass Burned (Gg CH4)
			C=(AxB)		E=(CxD)		G=(ExF)	H=(G(16/12))
Wood	7670.86	0.50	3835.43	0.87	3336.82	0.015	50.05	66.74
Agriculture Wastes	0.00	0.48	0.00	0.88	0.00	0.007	0.00	0.00
Dung	741.40	0.42	311.39	0.85	264.68	0.017	4.50	6.00
Charcoal Consumption	190.62	0.87	165.84	0.88	145.94	0.0014	0.20	0.27
Charcoal Production					0.00	0.090	0.00	0.00
				Total	3747.44		54.76	73.01
Charcoal Production								
Input(Wood)	0.00	0.87	0.00		0.00			
Output(Charcoal)	0.00	0.87	0.00		0.00			
Carbon Released					0.00			

Conversion Factor : Wood (0.360 ktoe/kt)
Bagasse (0.150 ktoe/kt)
Dung (0.350 ktoe/kt)
Charcoal (0.650 ktoe/kt)

kt : kilotonnes
dm : dry matter

ESTIMATING EMISSIONS OF CARBON MONOXIDE AND NITROUS OXIDE

RESIDENTIAL AND COMMERCIAL SECTOR

MODULE	ENERGY							
SUBMODULE	TRADITIONAL BIOMASS BURNED FOR ENERGY							
WORKSHEET	I-3							
SHEET	2 OF 3							
	STEP 4				STEP 5			
	I C-CO Trace Gas Emission Ratio	J C Emitted CO (kt C) (a)	K CO Emitted (Gg CO)	L Nitrogen-Carbon Fuel Ratio	M Total Nitrogen Released (kt N) (a)	N N-N2O Trace Gas Emissions Ratio	O Nitrogen Emitted as N2O (kt N)	P N2O Emitted (Gg N2O)
		J=(ExI)	k=(J*28/12)		M=(ExL)		O=(MxN)	P=(Ox44/28)
Wood	0.08	266.95	622.87	0.01	33.37	0.009	0.30	0.47
Agriculture Wastes	0.08	0.00	0.00	0.02	0.00	0.009	0.00	0.00
Dung	0.08	21.17	49.41	?		0.009		
Charcoal Consumption	0.08	11.67	27.24	?		0.009		
Charcoal Production	0.08	0.00	0.00	?		0.009		
		Total	699.52					0.47

(a). Data from Worksheet I-3 Sheet I of 3 (column E), Anex ...

Table D.6 CH4 and N2O National inventories for the Residential-commercial Susector

ESTIMATING CARBON CONTENT OF BIOMASS FUELS, CARBON RELEASED AND METHANE EMISSIONS
AGROPECUARIAN AND AGROINDUSTRIAL

MODULE	ENERGY							
SUBMODULE	TRADITIONAL BIOMASS BURNED FOR ENERGY							
WORKSHEET	I-3							
SHEET	I OF 3							
	STEP 1				STEP 2		STEP 3	
	A Biomass Consumed (kt dm)	B Carbon Fraction of Biomass	C Carbon Content (kt dm)	D Fraction Oxidised	E Total Carbon Released by Biomass Fuels (kt C)	F C-CH4 Ratio	G Carbon Emitted as CH4 (kt C)	H CH4 Emission from biomass Burned (Gg CH4)
			C=(AxB)		E=(CxD)		G=(ExF)	H=(G(16/12)
Wood	0.00	0.50	0.00	0.87	0.00	0.015	0.00	0.00
Agriculture Wastes	818.93	0.48	393.09	0.88	345.92	0.007	2.42	3.23
Dung	0.00	0.42	0.00	0.85	0.00	0.017	0.00	0.00
Charcoal Consumption	0.00	0.87	0.00	0.88	0.00	0.0014	0.00	0.00
Charcoal Production					0.00	0.090	0.00	0.00
				Total:	345.92		2.42	3.23
Charcoal Production								
Input(Wood)	0.00	0.87	0.00		0.00			
Output(Charcoal)	0.00	0.87	0.00		0.00			
Carbon Released					0.00			

Conversion Factor : Wood (0.360 ktoe/kt)
Bagasse (0.150 ktoe/kt)
Dung (0.350 ktoe/kt)
Charcoal (0.650 ktoe/kt)

kt : kilotonnes
dm : dry matter

ESTIMATING EMISSIONS OF CARBON MONOXIDE AND NITROUS OXIDE
AGROPECUARIAN AND AGROINDUSTRIAL

MODULE	ENERGY							
SUBMODULE	TRADITIONAL BIOMASS BURNED FOR ENERGY							
WORKSHEET	I-3							
SHEET	2 OF 3							
	STEP 4				STEP 5			
	I C-CO Trace Gas Emission Ratio	J C Emitted CO (kt C) (a)	K CO Emitted (Gg CO)	L Nitrogen-Carbon Fuel Ratio	M Total Nitrogen Released (kt N) (a)	N N-N2O Trace Gas Emissions Ratio	O Nitrogen Emitted as N2O (kt N)	P N2O Emitted (Gg N2O)
		J=(ExI)	k=(J*28/12)		M=(ExL)		O=(MxN)	P=(Ox44/28)
Wood	0.08	0.00	0.00	0.01	0.00	0.009	0.00	0.00
Agriculture Wastes	0.08	27.67	64.57	0.02	6.92	0.009	0.06	0.10
Dung	0.08	0.00	0.00	?		0.009		
Charcoal Consumption	0.08	0.00	0.00	?		0.009		
Charcoal Production	0.08	0.00	0.00	?		0.009		
		Total	64.57					0.10

(a). Data from Worksheet I-3 Sheet I of 3 (column E), Anex ...

Table D.7 CH4 and N2O National inventories for the Agropecurian-Agroindustrial Susector.