EXECUTIVE SUMMARY

This report presents Jamaica's greenhouse gas (GHG) inventory for the period 2000 to 2005. The inventory is a component of Jamaica's Second National Communication (SNC) to the United Nations Framework Convention on Climate Change (UNFCCC). Signatories to the Convention are requested to update and report periodically on their inventory of anthropogenic emissions and removals of greenhouse gases (GHGs) not controlled by the Montreal Protocol.

Jamaica, which is a Non - Annex 1 Party to the Convention, submitted its Initial National Communication (INC) in November 2000. The INC included a GHG inventory for the reference year 1994 in compliance with Articles 4 and 12 of the UNFCCC and in accordance with the Inter-governmental Panel on Climate Change (IPCC) Guidelines of 1996.

The reporting requirements for the SNCs for non-Annex 1 parties include the use of the Revised 1996 IPCC Guidelines but also invited non-Annex I Parties who so wished, to use elements from the guidelines used by Annex I countries when preparing their national communications. The Subsidiary Body for Scientific and Technological Advice (SBSTA) prepared the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (hereafter referred to as the *2006 Guidelines*) and encouraged Parties in a position to do so to gain experience with the 2006 IPCC Guidelines. Jamaica decided to use the methodologies contained in the 2006 Guidelines in preparing the inventories for the years 2000 to 2005.

The structure of this report is consistent with the *2006 Guidelines* and reports annual emissions and sinks for the direct GHGs namely, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) and the indirect GHGs (which contribute to tropospheric ozone (O_3) formation) non-methane volatile organic compounds (NMVOC), carbon monoxide (CO) and nitrogen oxides (NOx) and sulphur dioxide (SO_2).

Scope

The releases and sinks were estimated for sources and sinks in the following four sectors:

- Energy
- Industrial Processes and Product Use
- Agriculture, Forestry and Other Land Use; and
- Waste sectors.

Within each sector the methodologies used and data sources (activity and emission factor data) are indicated together with the presentation and discussion of emission estimates. Gaps, data constraints, methodological problems and uncertainties in compiling the GHG emission estimates are identified within each sector.

The lack of a complete archive of data for the 1994 inventory precluded recalculation of the 1994 inventory using the *2006 Guidelines* and the investigation of apparent anomalies in estimates of the CO_2 sink in the forestry sector and CH_4 emissions from soils in the 1994 estimates.

Results (Tables and figures cited in the Executive Summary are provided at the end of the section).

Overall national and sectoral emissions for 2000 are given in Table 1 and are illustrated in Figure 1. The net CO_2 emissions increased from 8,418 Gg in 1994 to 9,532 Gg in 2000. The energy sector accounts for nearly 86% of the 2000 CO_2 emissions (it was 97% in 1994). The total estimated CO_2 removals (sinks) in 1994 were 167 Gg while in 2000 the sinks were 1,108 Gg. Sufficient data (emission factors) were not available to determine the reasons for the large change – an apparent discrepancy. The Agriculture, Forestry and Other Land Use sector was responsible for the sink (see Figure 2).

The sectoral contributions to CH_4 and N_2O emissions in 2000 are illustrated in Figures 3 and 4. CH_4 emissions in 1994 were estimated at 58.5 Gg and 34.7 Gg in 2000. The estimates for CH_4 emissions from enteric fermentation (36 Gg) and manure management (7 Gg) were considerably higher than those in 2000 (8.17 Gg and 0.646 Gg respectively). The waste sector accounted for 54% of the CH_4 emissions in 2000 followed by Agriculture, Forestry and Other Land Use (26% and Energy (20%) (see Figure 4).

N_2O emissions in 1994 were estimated at 344 Gg and 11.7 Gg in 2000. The reason for the large discrepancy between the 1994 and 2000 estimates could not be determined since raw data used in the calculations for 1994 were not available. Managed soils (fertiliser applications) accounted for 80% of the N_2O emissions.

Estimates for HFCs emissions were not made in 1994 but were 5.16 Gg CO_2 equivalents in 2000.

Emissions of the indirect GHGs, NOx, CO, NMVOCs and SO_2 over the period 2000 to 2005 are shown in Figure 5.

NOx emissions were estimated at 30.9 Gg in 1994 and 35.9 Gg in 2000. CO, NMVOC and SO_2 emissions in 1994 were respectively 173 Gg, 29.1 Gg and 98.9 Gg. The comparable estimates in 2000 were 205 Gg for CO_2, 27.6 Gg NMVOC and 173 Gg for SO_2. The transport sector accounts for the majority of Co and NMVOC emissions; the energy industries (electricity generation) and Manufacturing categories account for the majority of SO_2 emissions.

Trends between 2000 and 2005

The methodologies used in compiling the current inventory (according to the IPCC 2000 Guidelines) are different from those used to compile the 1994 inventory. Archived activity data for the 1994 inventory were incomplete (especially for the agriculture and forestry sectors) and hence it was not feasible to reconstruct the 1994 inventory using the 2006 methodologies. Because of this, trends in emissions are discussed only for the period 2000 to 2005.

Annual emissions for CO_2, CH_4 and N_2O are shown in Figure 6. CO_2 emissions increased consistently from 9,531 Gg in 2000 to 13,956 Gg in 2005. There were similar consistent increases for CH_4 emissions which rose from 31.1 Gg in 2000 to 41.9 Gg in 2005. The large (46%) increase in CO_2 emissions was due to increases in energy sector fuel consumption in the manufacturing (bauxite and alumina industry) and transportation categories (see Figure 7). There was little change in the magnitudes of the sources and sinks for CO_2 in the Agriculture, Forestry and Other Land Use sector (see Figure 8) over the period.

In the Industrial Processes and Products Use Sector, the CO_2 emissions from cement industry increased over the period but those due to lime manufacture declined (see Figure 8). Importation of lime was required to meet the alumina industry demands.

CO_2 emissions in the waste sector increased over the period but the contribution from managed disposal sites decreased while that from unmanaged sites increased (see Figure 9). There was a similar pattern for CH_4 emissions (Figure 10) since CH_4 emissions from managed sites decreased while those from unmanaged sites increased.

Uncertainties

Uncertainties in the overall inventory were estimated based on the uncertainties in emission factors and activity data. Calculations were based on to the recommendations in the *2006 Guidelines Volume I: General Guidance and Reporting*. The *2006 Guidelines* recommend evaluation of the uncertainties in the annual estimates as well as in trends. This was done for 2005 inventory using 2000 as the base year and estimates of the uncertainty alone were made for the year 2000. The estimates were made using Approach 1 in which the error propagation in the activity data and emission factor data were combined. For those cases where the uncertainties in emission factors were asymmetric, a simplified approach was used – based on averaging the modulus of positive and negative uncertainty ranges (i.e., ignoring the sign of the uncertainty).

The overall uncertainties in the 2000 and 2005 inventories were about 10% while the uncertainty in the trend between 2000 and 2005 was 16%. CO_2 accounted for between 70 and 77% of the emissions on a CO_2 equivalent basis. Most of the CO_2 emissions are from fuel combustion which, apart from some transportation categories in general, have low uncertainties.

Data Gaps and Suggested Improvements

<u>Energy Sector</u>

- Compile fuel use and other activity data (production) by at least four digit ISIC codes. Where quantities are small and not readily or cost effectively compiled or disaggregated, the data collection should be geared to provide aggregates based on ISIC codes.
- The current compilation of fuel consumption data are based on sectors (which can be identified with ISIC codes) and geography (namely, rural and urban) which cannot be identified with economic activity (ISIC codes).
- Data collection should be improved in order to allow better distinctions of diesel fuel use to be made between on-road and off road transportation activities and other fuel combustion activities by sector.
- Fuel consumption data for some mining activities (bauxite mining by third party companies) and for lime production should be captured
- Fuel consumption for aircraft registered in Jamaica should continue to be compiled. This will be even more critical after closure of one of the domestic aerdromes and its relation to the Norman Manley International Airport.
- Production data for lime production should be reported for all manufacturing facilities.
- The vehicle fleet data base contains many serious discrepancies which should be corrected over time by implementing quality assurance and quality control

procedures to avoid data entry errors (weights, vehicle age, manufacturers etc.). and minimise other errors (fuel type, VIN numbers).

Industrial Processes and Product Use Sector

- Although the uncertainty in emissions from cement manufacture is low, some enhancement could be made by using chemical analyses for clinker produced.
- Import data for HFCs did not always identify all items in shipments. Because of the wide variation and relatively high global warming potentials for HFCs, such identification is essential for obtaining more reliable estimates.
- HFCs have been and are being used in fire suppression systems but data on the systems in place are lacking
- Paint production data that are compiled and reported and paint specifications do not allow the key environmental issue regarding paints to be addressed. The current specifications include volatile matter which includes water – instead of isolating volatile organic compounds. Revision of the standards based on paint types such as those used in North America or Europe (but adapted to Jamaica's market) is recommended.

Agriculture, Forestry and Other Land Use Sector

- The assignments of land use and changes in land use categories are based on outdated satellite imagery. Updated satellite imagery data complemented by suitable ground based surveys and permanent sample plots to measure growth rates are needed in order to improve the quality of the land use change data and to develop country–specific growth rates. This information will significantly improve the accuracy of the inventories for as well as inform land use policies and forestry management.
- Agricultural census data are compiled approximately every 10 years and mechanisms should be established to allow estimates in the intervening years for those data that are important but not currently compiled. These include data for goats, sheep as well as manure management practices for all animals and the amounts of crop residues remaining in the fields.
- Information on the wood conversion (removals for various purposes e.g., fuel wood, timber, agricultural purposes) on privately owned lands is lacking. The design of suitable, viable solutions to obtain such data is challenging but options that should be considered include legislation and well designed, periodic surveys.
-

Waste Sector.

- Reliable data on the loading (volume and BOD or COD) of releases from sewage treatment and industrial wastewater plants are lacking. The enactment and enforcement of Wastewater and Sludge Regulations being drafted by NEPA should remedy this situation.
- Reliable data for the types and quantities of industrial waste generated and disposed of in municipal and industrial waste disposal sites are lacking.
- Some data for municipal waste are now being compiled by the NSWMA but ongoing and additional determination and estimates of waste stream disposal

methods (collected, uncollected, treatment methods including open burning) will assist in making more reliable inventory estimates as well as inform waste reduction and other waste management strategies.

- Enactment of Pollutant Release and Transfer Regulations will also assist in providing data for air emissions, trade effluent and solid waste releases and transfers and transfers and also provide a mechanism for ongoing compilation and archiving of these data.
- Additional information on population according to income groups and the degree of utilisation of sewage treatment systems (sewered, not sewered, pit latrines) by parish and urban and rural areas is needed.
- Data on the quantities and disposal and treatment methods of clinical and industrial solid wastes are lacking. The recently enacted Air Quality Regulations (2006) under the NRCA Act should improve some of the data availability (e.g., when waste is incinerated) for future inventories.
- While challenging, NEPA needs to ensure that small facilities which do not fall within the licensing system of the Air Quality Regulations (2006) use the best available technology and /or best practices to operate their facilities.
-

Conclusion

- In most of the above cases the improvements will greatly facilitate the core business of data suppliers. This is especially true of the energy sector/fuel use data where reliable energy end use information is so critical in identifying opportunities for improving energy efficiency and reducing fuel use.

Table 1 Summary of Jamaica's Greenhouse Gas Emissions in 2000

	Categories	Net CO_2	CH_4	N_2O	HFCs	NOx	CO	NMVOCs	SO_2
		(Gg)			CO_2 Equivalents (Gg)	(Gg)			
	Total National Emissions and Removals	**9,532**	**31.7**	**9.86**	**4.13**	**34.0**	**191**	**23.9**	**173**
1	**ENERGY**	**10,066**	**3.77**	**1.23**		**34.0**	**191**	**20.0**	**171**
1A	Fuel Combustion Activities	10,062	3.77	1.23		34	191	19	171
1B	Fugitive Emissions from Fuels	4.21	7.31E-05	7.308E-06		0.00	0.00	1.46	0.00
1C	Carbon Dioxide Transport and Storage								
2	**INDUSTRIAL PROCESSES AND PRODUCT USE**	**537**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
2A	Mineral Industry	497	0.00	0.00					
2B	Chemical Industry	0.00	0.00	0.00					
2C	Metal Industry	0.00	0.00	0.00					
2D	Non-Energy Products from Fuels and Solvent Use	40.1	0.00	0.00					
2E	Electronics Industry	0.00	0.00	0.00					
2F	Product Uses as Substitutes for Ozone Depleting Substances	0.40	0.00	0.00	4.13				
2G	Other Product Manufacture and Use								
2H	Other								
3	**AGRICULTURE, FORESTRY AND OTHER LAND USE**	**-1,108**	**8.82**	**8.34**		**0.00**	**0.00**	**0.00**	**0.00**
3A	Livestock		8.82	0.19		0.00	0.00	0.00	0.00
3B	Land	-1,116	0.00	0.00					
3C	Aggregate Sources and Non-CO_2 Emissions Sources on Land	7.56	0.00230	8.16		0	0	0.00	0.00
3D	Other	0.00	0.00	0.00		0.00	0.00	0.00	0.00
4	**WASTE**	**36.3**	**19.1**	**0.1**	**0.0**	**0.0**	**0.3**	**3.9**	**1.4**
4A	Solid Waste Disposal		13	0.00					
4B	Biological Treatment of Solid Waste		0.00	0.00					
4C	Incineration and Open Burning of Waste	36.3	0.602	0.014	0	0	0.279	3.90	1.39
4D	Wastewater Treatment and Discharge	0.0	5.06	0.111	0	0	0	0	0
4E	Other (please specify)	0	0	0	0	0	0	0	0
5	**OTHER**	0	0	0.164	0	0	0	0	0
5A	Indirect N_2O Emissions from the Atmospheric Deposition of Nitrogen in NOx and NH_3	0	0	0	0	0	0	0	0
5B	Other (please specify)	0	0	0.164	0	0	0	0	0
	Memo items (5)								
	InternationalBunkers	**336**	**0.002**	**0.009**	**0.000**	**0.000**	**1.16**	**6.42**	**0.333**
	International Aviation (International Bunkers)	272	0.002	0.008		0	0.95	0.42	0.19
	International Water-borne Transport (International Bunkers)	64	0.000	0.002		0	0.21	6.01	0.14
	Multilateral Operations	0	0	0	0	0	0	0	0

Figure 1 Jamaica's Greenhouse Gas Emissions in 2000

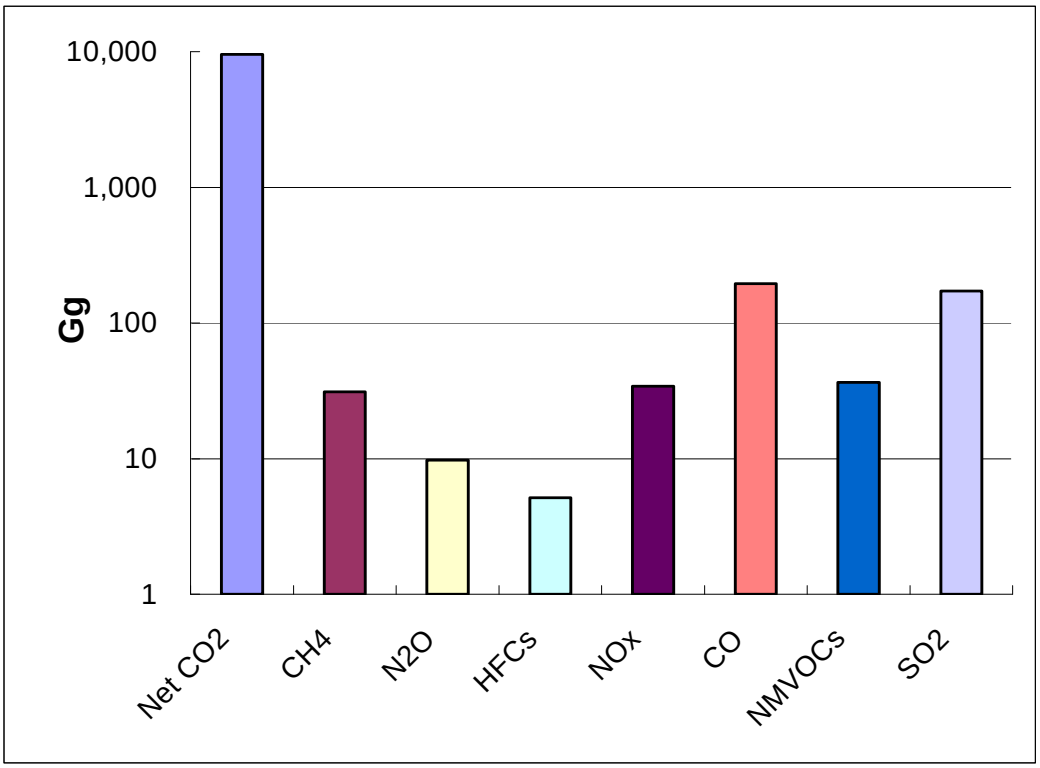

Figure 2 Sectoral CO_2 Emissions: 2000

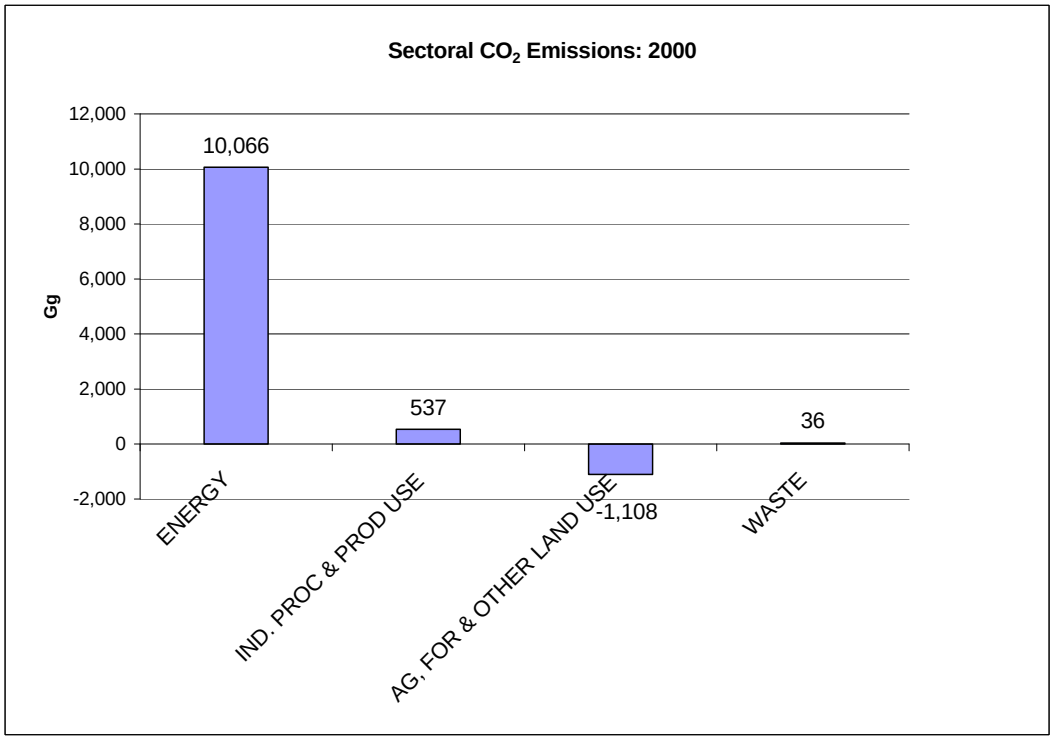

Figure 3 Sectoral CH_4 Emissions: 2000

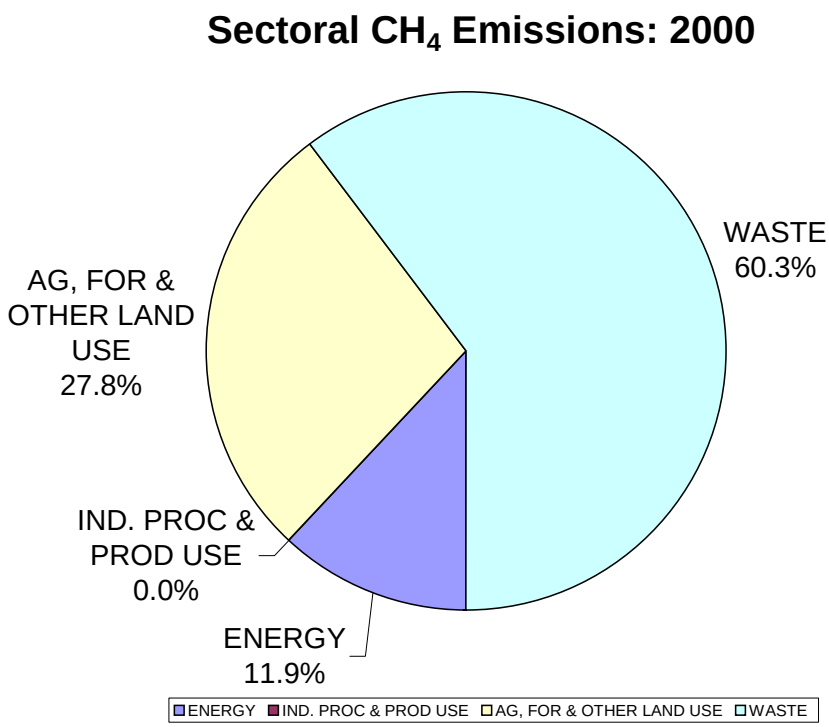

Figure 4 Sectoral N_2O Emissions: 2000

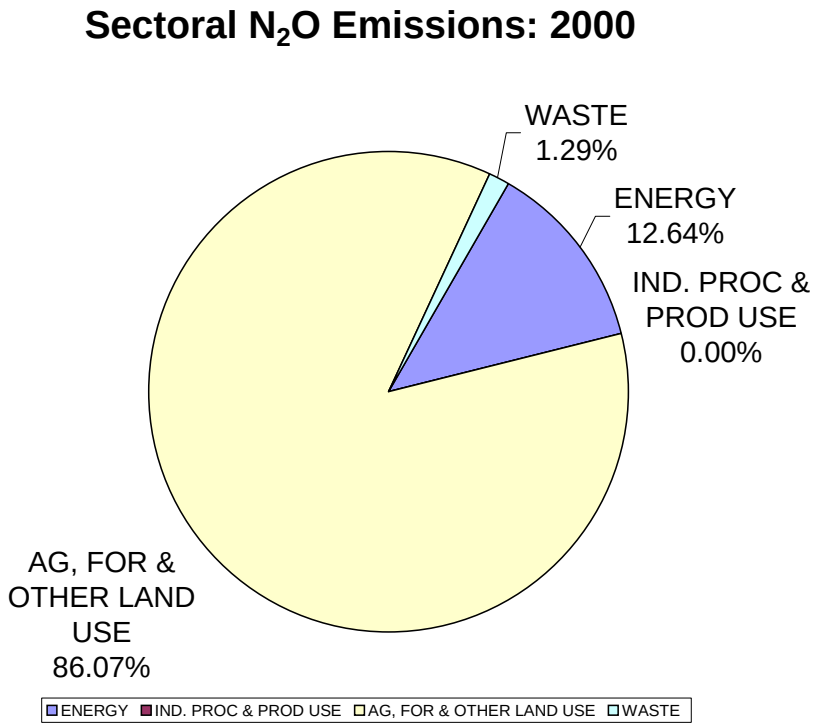

Figure 5 NOx, CO, NMVOC and SO_2 Emissions: 2000

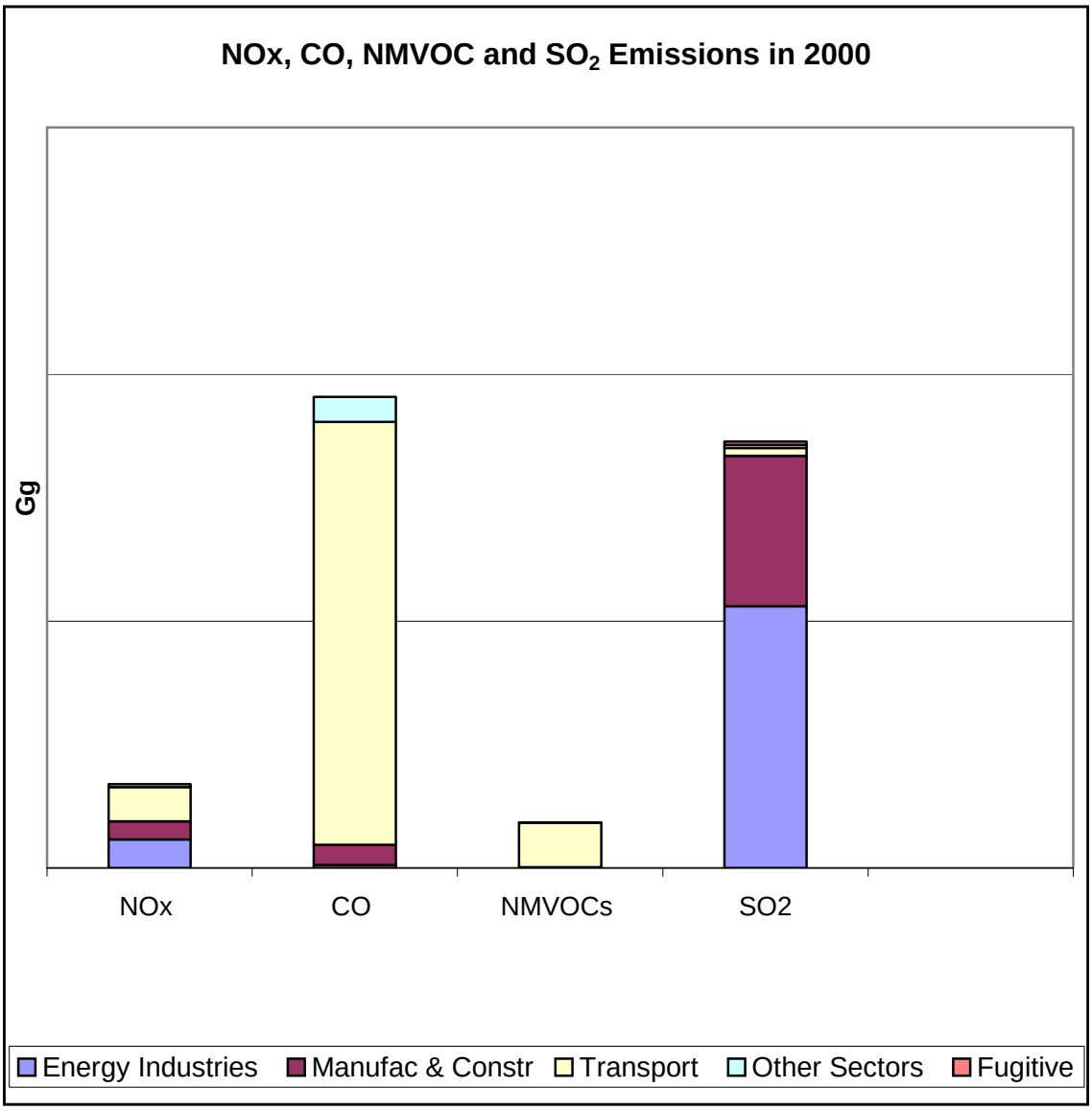

Figure 6 CO_2 , N_2O and CH_4 Emissions: 2000 to 2005

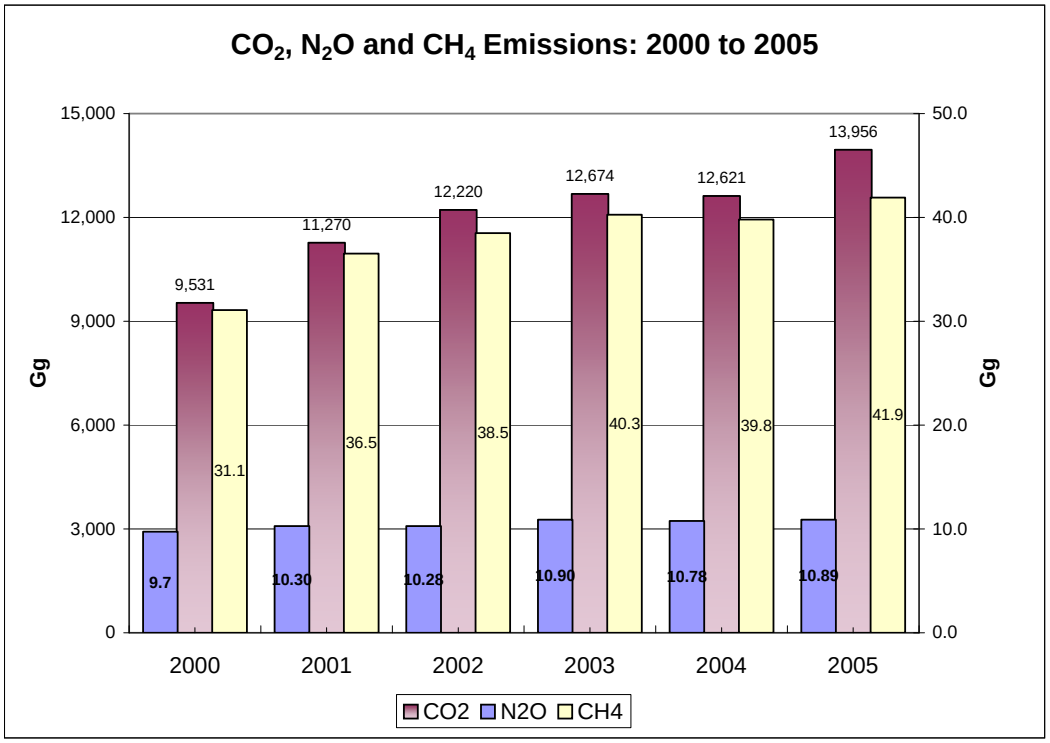

Figure 7 Energy Sector CO_2 Emissions: 2000 to 2005

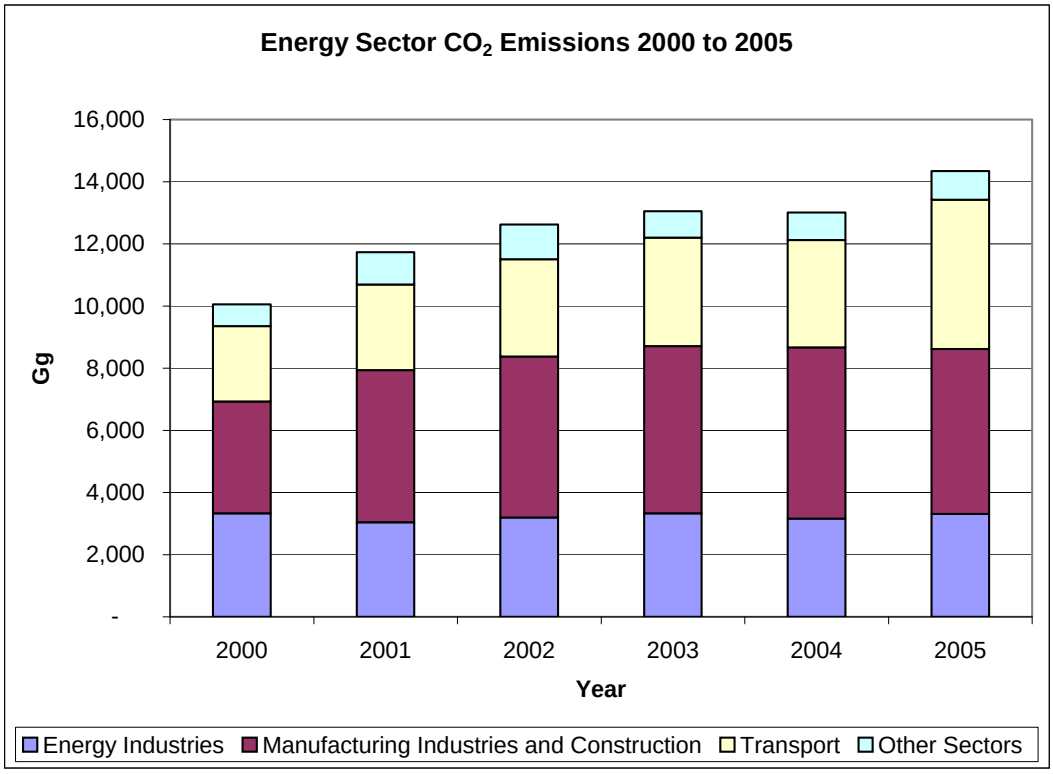

Figure 8 Industrial Processes and Product Use CO_2 Emissions: 2000 to 2005

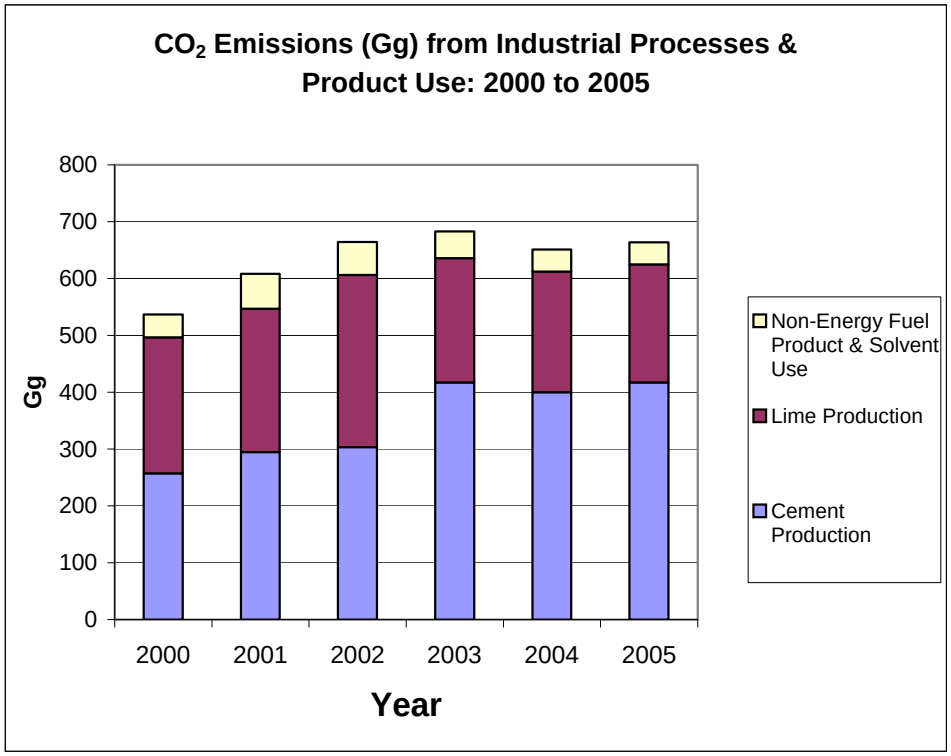

Figure 9 Waste Sector CO_2 Emissions: 2000 to 2005