

AIR1: EMISSIONS OF SULPHUR DIOXIDE (SO₂)**H****Concept and Definition**

Sulphur dioxide, or SO₂, belongs to the family of sulphur oxide gases (SO_x). These gases dissolve easily in water. Sulphur is prevalent in all raw materials, including crude oil, coal, and ore that contains common metals like aluminium, copper, zinc, lead, and iron. SO_x gases are formed when fuel-containing sulphur, such as coal and oil, is burned, and when gasoline is extracted from oil, or metals are extracted from ore. SO₂ dissolves in water vapour to form acid, and interacts with other gases and particles in the air to form sulfates and other products that can be harmful to people and their environment.

Over 65% of SO₂ released to the air, or more than 13 million tons per year, comes from electric utilities, especially those that burn coal. Other sources of SO₂ are industrial facilities that derive their products from raw materials like metallic ore, coal, and crude oil, or that burn coal or oil to produce process heat. Examples are petroleum refineries, cement manufacturing, and metal processing facilities. Also, locomotives, large ships, and some nonroad diesel equipment currently burn high sulphur fuel and release SO₂ emissions to the air in large quantities. (see <http://www.epa.gov/air/urbanair/so2/> [last accessed: July 14th 2009]).

Definitions of selectable source categories

Fuel combustion (Sectoral Approach): Total emissions of all greenhouse gases from all fuel combustion activities.. Other greenhouse gases from biomass fuel combustion are considered net emissions and are included. Incineration of waste for waste-to-energy facilities are included here and not under Waste. Emissions from fuel used in ships or aircraft engaged in international transport are not included here.

Energy Industries comprises emissions from fuels combusted by the fuel extraction or energy producing industries.

Transport: Emissions from the combustion and evaporation of fuel for all transport activity, regardless of the sector. Emissions from fuel sold to any air or marine vessel engaged in international transport (international bunker fuels) are not included.

Industrial Processes: By-product or fugitive emissions of greenhouse gases from industrial processes. Emissions from fuel combustion in industry are included under Fuel Combustion.

Solvent and Other Product Use: Emissions resulting from the use of solvents and other products containing volatile compounds. When the solvents and other products are, or are produced from, petroleum products, the carbon in the NM-VOC emissions will be included in the CO₂ inventory if the Reference Approach for CO₂ emissions from energy is used. All other non-energy emissions not included under Industrial Processes are included here.

Agriculture: All anthropogenic emissions from agriculture except for fuel combustion and sewage emissions.

Other: Emissions that do not fit under any other emission source/sink categories of the main categories described above.

Method of Computation

Air emissions data are usually estimated according to international methodologies on the basis of national statistics on energy balances, industrial and agricultural production, waste management and land use, etc. The most accepted and well-known methodologies are the revised 1996 Guidelines of the Intergovernmental Panel for Climate Change (IPCC) (see <http://www.ipcc-nggip.iges.or.jp/public/gl/invs4.html> [last accessed: July 2nd 2009]) which is the basis for reporting to the United Nations Framework Convention for Climate Change (UNFCCC) (see: <http://unfccc.int/index.html>). These are linked to the UNECE EMEP/CORINAIR Atmospheric Inventory Guidebook (see <http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html> [last accessed: July 2nd 2009]).

Sulphur dioxide emissions are measured (and regulated, where appropriate) for a number of activities, for example electric power plants and large industrial installations. For those activities for which direct measurements are not directly available, it is possible to estimate emissions by considering the amount of fuel consumed, together with emission factors related to particular combustion processes. In order, however, to determine the appropriate emission factor for these activities it is imperative to have relevant statistical data related to the fuel characteristics, and machinery specifications, taking into account the effects of various control techniques (e.g. disulphurisation units etc.). It must be noted that detailed methodologies (such as the CORINAIR programme) already exist for the estimation of SO₂ emissions from all anthropogenic activities. The unit of measurement is Kt SO₂ per year.

Indicator Relevance

Sulphur dioxide emissions are partly responsible for acid depositions on the surface and the occurrence of winter smog episodes. In addition, the oxidisation of SO₂ has also been found to contribute to visibility degradation due to high concentrations of aerosol sulphates in the atmosphere.

Data Assessment

All reporting Member States followed the internationally recommended definitions for emissions of Sulphur dioxide. This indicator is, therefore, regionally and internationally conceptually harmonized.

Only two of the reporting eighteen Member States/Associate Members of the Community provided data for this indicator.

Data Sources

In accordance with the decision that the UNSD would provide data on waste, water, land, and air to the CARICOM Secretariat, data for this indicator was collected from the UNSD instead of from Member States and Associate Members.

Please refer to **Appendix 1.10.1 (a)** for the original sources of the data, as specified by the UNSD, on air for Member States and Associate Members.

Evaluation

Tables 10.1 (a) and (b) show estimated SO₂ emissions for Jamaica in 1994 and for Trinidad and Tobago in 1990 and 1996. The data shows that *Manufacturing industries and construction* in Jamaica accounted for 63 per cent of total emissions reported for *energy activities and industrial processes* only, with a further 30 per cent coming from *fuel use* in energy industries. Emissions from *road transport* registered 2.1 thousand tonnes or 2 per cent of total emissions while emissions from *other fuel combustion* were estimated at 3.59 thousand tonnes. Jamaica also reported *total fugitive emissions* from fuels at 0.61 thousand tonnes.

Total SO₂ emissions in Trinidad and Tobago in 1990 and 1996 were 8.7 and 8.6 thousand tonnes respectively. According to the Environmental Management Authority of Trinidad and Tobago, *industrial processes* accounted for 3 per cent of total reported emissions while *energy activities* (fuel combustion in energy industries, industry, and transport, plus industrial processes) represented 97 per cent of the total sulphur dioxide emissions in 1990. The per cent share of *industrial processes* in total emissions declined to 2 per cent in 1996. *Emissions from transport* accounted for 70 per cent of total emissions reported for *energy activities* in 1996 followed by the *Energy Industry* (20 per cent) and *Manufacturing industries and construction* (8 per cent).

Table 10.1 (a) - Emissions of Sulphur Dioxide (SO₂): 1990, 1994 and 1996

(1000 t)

Country	Year	TOTAL emissions	TOTAL Energy activities	Industrial processes	Solvent use	Agriculture	Other sources of emissions
JM	1994	a 99.7	99.46	0.24			
TT	1990 ^a	8.7	8.5	0.2			
		b	c	e			
	1996	8.6	8.4	0.2			

Table 10.1 (b) - Emissions of Sulphur Dioxide (SO₂) from Energy Activities: 1990, 1994 and 1996

(1000 t)

Country	Year	TOTAL Energy activities	Total fugitive emissions from fuels	Total fuel combustion			
				Energy industries	Manufacturing industries and construction	Transport	Other fuel combustion
JM	1994	99.46	0.61	30.12	63.04	2.10	3.59
TT	1990 ^a	8.5	0.0				
		c	c	c d	d	d	
	1996	8.4	0.0	1.7	0.7	6.0	

AIR2: EMISSIONS OF NITROGEN OXIDES (NO_x)**H****Concept and Definition**

Nitrogen oxides, or NO_x, is the generic term for a group of highly reactive gases, all of which contain nitrogen and oxygen in varying amounts. Many of the nitrogen oxides are colorless and odorless. However, one common pollutant, nitrogen dioxide (NO₂) along with particles in the air can often be seen as a reddish-brown layer over many urban areas. Nitrogen oxides form when fuel is burned at high temperatures, as in a combustion process. The primary manmade sources of NO_x are motor vehicles, electric utilities, and other industrial, commercial, and residential sources that burn fuels. NO_x can also be formed naturally.

Nitrogen oxides are indirect greenhouse gases. They have been the target of environmental policies for their role in forming ozone (O₃), as well for their direct acidification effects. Fuel combustion activities are the most significant anthropogenic source of NO_x. Within fuel combustion, the most important sources are the energy industries and mobile sources.

Please refer to AIR2 for definitions of selectable source categories.

Method of Computation

Local authorities perform regular inspections in order to determine the conformity of a number of works and activities with environmental regulations. In this context, NO_x emissions are measured (and regulated, where appropriate) for a number of activities, for example electricity production stations and large industrial installations. For those activities for which measurements are not directly available, it is possible to estimate emissions by considering the amount of fuel consumed (both fossil fuels and biomass) together with emission factors related to particular combustion processes. The total annual amount of nitrogen oxides emissions must be derived for all economic activities, and particularly energy production and transformation, industry, transportation and domestic and tertiary sectors. The unit of measurement is Kt NO_x per year.

Indicator Relevance

The purpose of this indicator is to identify the activities mostly responsible for the release of nitrogen oxides into the atmosphere. Nitrogen oxides emitted into the atmosphere can be transported over large distances and can be deposited at the surface often hundreds or thousands of kilometres away from the site of the source. They are partly responsible for a series of problems, including acidification and increased concentration of photo-oxidants in the atmosphere that result in the occurrence of photochemical smog episodes. Nitrogen oxides are also associated with both respiratory morbidity and mortality in humans.

Data Assessment

All reporting Member States followed the internationally recommended definitions for emissions of Nitrogen oxides. This indicator is, therefore, regionally and internationally conceptually harmonized.

Only three of the reporting eighteen Member States/Associate Members of the Community provided data for this indicator.

Data Sources

In accordance with the decision that the UNSD would provide data on waste, water, land, and air to the CARICOM Secretariat, data for this indicator was collected from the UNSD instead of directly from Member States and Associate Members.

Please refer to **Appendix 1.10.2 (a)** for the original sources of the data, as specified by the UNSD, on air for Member States and Associate Members.

Evaluation

Tables 10.2 (a) and (b) provides data on emissions of *Nitrogen Oxides* (NO_x) for Jamaica, Suriname and Trinidad and Tobago. Suriname's total reported *Nitrogen Oxides* emissions declined by 49 per cent from 1975 to 1999, decreasing from 20.1 thousand tonnes in 1975 to 10.3 thousand tonnes in 1999. Suriname's data also reveals that following an initial drop in emissions by 66 per cent for the five year period 1980 to 1985, emissions increased stealthily towards the end of the period. Data reported for Jamaica in 1994 reveals that road transport contributed to 39 per cent of total emissions from energy activities followed by emissions from manufacturing industries which contributed 35 per cent of total emissions while energy industries and other fuel combustion contributed to 19 per cent and 6 per cent of total emissions respectively. In 1990, Trinidad and Tobago registered total emissions of Nitrogen Oxides at 37.2 thousand tonnes comprising 97 per cent emissions from energy activities.

Table 10.2 (a) - Emissions of Nitrogen Oxides (NO_x): 1975-1999

(1000 t)

Country	Year	TOTAL emissions	TOTAL Energy activities	Industrial processes	Solvent use	Agriculture	Other sources of emissions
JM	1994	a 30.92	30.92				
SR	1975	20.1					
	1980	25.0					
	1985	8.6					
	1990	8.9					
	1995	9.9					
	1998	10.2					
	1999	10.3					
TT	1990 ^a	37.2	36.1	0.1		0.4	0.6
	1996						

Table 10.2 (b) - Emissions of Nitrogen Oxides (NO_x) from Energy Activities: 1975-1999

(1000 t)

Country	Year	TOTAL Energy activities	Total fugitive emissions from fuels	Total fuel combustion			
				Energy industries	Manufacturing industries and construction	Transport	Other fuel combustion
JM	1994	30.92	0.04	5.94	10.83	12.20	1.91
SR	1975						
	1980						
	1985						
	1990						
	1995						
	1998						
	1999						
TT	1990 ^a	36.1	35.1				0.4
	1996			12.9	2.5	25.6	

AIR3: EMISSIONS OF NON-METHANE VOLATILE ORGANIC COMPOUNDS (NM-VOCs)**H****Concept and Definition**

Non-methane volatile organic compounds (NM-VOCs) are a group of solvent-like organic compounds that easily evaporate at normal temperatures. They are produced mainly in fuel combustion and in processes that use solvents or solvent-based products such as painting, metal degreasing etc. Several of these chemicals are harmful to human health if inhaled, ingested, drunk or get in contact with skin. NM-VOCs are significant precursors to ground level ozone formation. NM-VOCs are the sum of all hydrocarbon air pollutants except methane.

Non-methane volatile organic compounds emissions from anthropogenic activities are primarily comprised of total emissions from the use of fuels for energy purposes, evaporative emissions during industrial processes and non-industrial use of organic solvents.

Please refer to AIR2 for definitions of selectable source categories.

Method of Computation

The total annual amount of non-methane volatile organic compounds emissions must be derived for all economic activities, and particularly energy-related activities, industrial processes and non-industrial use of organic solvents. The unit of measurement is Kt of NM-VOCs per year.

Indicator Relevance

The purpose of this indicator is to identify the activities mostly responsible for the release of non-methane volatile organic compounds into the atmosphere. The annual NM-VOCs emissions are directly related to the amount of biomass and fossil fuels used for energy production, the amount of solid and liquid fossil fuels that is produced, transported, distributed and stored, and the quantity of organic solvents used for non-industrial purposes.

Data Assessment

All reporting Member States followed the internationally recommended definitions for emissions of Non-methane volatile organic compounds (NM-VOCs). This indicator is, therefore, regionally and internationally conceptually harmonized.

Only two of the reporting eighteen Member States/Associate Members of the Community provided data for this indicator.

Data Sources

In accordance with the decision that the UNSD would provide data on waste, water, land, and air to the CARICOM Secretariat, data for this indicator was collected from the UNSD instead of directly from Member States and Associate Members.

Please refer to **Appendix 1.10.3 (a)** for the original sources of the data, as specified by the UNSD, on air for Member States and Associate Members.

Evaluation

Data on Emissions of Non-Methane Volatile Organic Compounds (NM-VOCs) for Jamaica and Trinidad and Tobago are provided in **Tables 10.3(a)** and **(b)** below. Estimations for Jamaica for 1994 are presented for *energy activities* and *industrial processes* only and reveal that *transport* contributes to 57 per cent of total emissions followed by *other fuel combustion* activities which contributed to 20 per cent of total emissions. Manufacturing industries and construction contribute to 0.8 per cent of total emissions in this Member State while Energy industries contributed to 0.4 per cent of total emissions of NM-VOCs. Total emissions of NM-VOCs for Trinidad and Tobago in 1996 was estimated at 93.1 thousand tonnes of which energy activities accounted for 66 per cent of emissions while Industrial processes accounted for 34 per cent.

Table 10.3 (a) - Emissions of Non-Methane Volatile Organic Compounds (NM-VOCs): 1990 and 1994

(1000 t)

Country	Year	TOTAL emissions	TOTAL Energy activities	Industrial processes	Solvent use	Agriculture	Other sources of emissions
JM	1994	a 34.89	29.05	5.84			
TT	1990 ^a	93.1	61.1	32.0			

Table 10.3 (b) - Emissions of Non-Methane Volatile Organic Compounds (NM-VOCs) from Energy Activities: 1990 and 1994

(1000 t)

Country	Year	TOTAL Energy activities	Total fugitive emissions from fuels	Total fuel combustion			
				Energy industries	Manufacturing industries and construction	Transport	Other fuel combustion
JM	1994	29.05	1.63	0.15	0.28	20.02	6.97
TT	1990 ^a	61.1	33.2				

AIR4: EMISSIONS OF CARBON DIOXIDE (CO₂)**H****Concept and Definition**

Carbon dioxide (CO₂) is a colourless, odourless and non-poisonous gas formed by combustion of carbon and in the respiration of living organisms and is considered a greenhouse gas.

Carbon dioxide (CO₂) is the most common greenhouse gas produced by anthropogenic activities, accounting for about 60 per cent of the increase in radiative forcing since preindustrial times (IPCC, 1992). By far the largest source of CO₂ emissions is from the oxidation of carbon when fossil fuels are burned, which accounts for 70-90 per cent of total anthropogenic CO₂ emissions. When fuels are burned, most carbon is emitted as CO₂ immediately during the combustion process. Some carbon is released as CO, CH₄, or non-methane hydrocarbons, which oxidise to CO₂ in the atmosphere within a period from a few days to 10-11 years.

United Nations. United Nations Framework Convention on Climate Change (A/AC.237/18 (Part II)/Add.1 and Corr.1). Opened for signature at Rio de Janeiro on 4 June 1992. (Section C)

United Nations. Glossary of Environment Statistics. Series F, No. 67 (United Nations publication, Sales No. E.96.XVII.12).

<http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch1ref1.pdf>

Please refer to AIR2 for definitions of selectable source categories.

Method of Computation

Total anthropogenic carbon dioxide (CO₂) emissions from the sectors energy, industrial processes, solvent and other product use, agriculture, land use change and forestry, and waste. Since CO₂ removals are also accounted for, this indicator concerns net emissions. Natural emissions are not accounted for. The unit of measurement is tonnes CO₂ per year.

Indicator Relevance

The scientific community acknowledges that atmospheric concentrations of CO₂ have continued to increase, and that “the balance of evidence suggests a discernible human influence on global climate”. Future climate change is expected to have major impacts on e.g. agriculture, water resources, ecosystems and human health. The indicator is linked to the indicators of other greenhouse gases. Furthermore, the indicator is linked to those in the area of Ozone Depletion. Ozone is a greenhouse gas, and therefore changes in stratospheric ozone should be considered in assessing climate change. Moreover, greenhouse gases are believed to affect stratospheric ozone depletion. These effects include both positive and negative effects.

Data Assessment

All reporting Member States followed the internationally recommended definitions for emissions of Carbon dioxide (CO₂). This indicator is, therefore, regionally and internationally conceptually harmonized.

Only three of the reporting eighteen Member States/Associate Members of the Community provided data for this indicator with countries reporting data for select categories only.

Data Sources

In accordance with the decision that the UNSD would provide data on waste, water, land, and air to the CARICOM Secretariat, data for this indicator was collected from the UNSD instead of from Member States and Associate Members.

Please refer to **Appendix 1.10.4 (a)** for the original sources of the data, as specified by the UNSD, on air for Member States and Associate Members.

Evaluation

Three CARICOM Member States reported Emissions of Carbon Dioxide (CO₂). Suriname reported data in three year gaps revealing average emissions of 1.9 million tonnes for the period 1981 to 1997. Estimates of CO₂ emissions for Jamaica in 1994 for energy activities and industrial processes only revealed that emissions from energy activities totalled 8.2 million tonnes comprising the combustion of fuels from various activities while Industrial processes totalled 0.4 million tonnes. 50 per cent of emissions caused by the burning of fossil fuels resulted from activities in manufacturing industries and construction while activities in energy industries accounted for 27 per cent. Road transport and other fuel combustion accounted for the remaining 23 per cent. CO₂ emissions for Trinidad and Tobago were reported for 1990, 1996 and 2000. Data for 1990 were reported for energy activities from fuel combustion which totalled 9.9 million tonnes and industrial processes totalling 5.1 million tonnes. In 1996 a figure of 3.7 million tonnes was reported for energy activities within energy industries. Trinidad and Tobago emissions caused by the burning of fossil for the year 2000 was reportedly 11.7 million tonnes of which manufacturing industries and construction accounted for 68 per cent, energy industries accounted for 18 per cent, road transport for 12 per cent and other fuel combustion accounted for the remaining 2 per cent.

Table 10.4 (a) - Emissions of Carbon Dioxide (CO₂): 1981-2000, various years

(million tonnes)

Country	Year	TOTAL emissions	TOTAL Energy activities	Industrial processes	Solvent use	Agriculture	Other sources of emissions
JM	1994		8.20	0.38			
SR	1981	2.0					
	1983	1.4					
	1985	1.6					
	1987	1.8					
	1989	1.9					
	1991	2.1					
	1993	2.1					
	1995	2.1					
	1997	2.1					
TT	1990 ^a	15.0	9.9	5.1			
	1996 ^b						
	2000 ^c	11.7 ^d					

Table 10.4 (b) - Emissions of Carbon Dioxide (CO₂): 1981-2000, various years

(million tonnes)

Country	Year	TOTAL Energy activities	Total fugitive emissions from fuels	Total fuel combustion			
				Energy industries	Manufacturing industries and construction	Transport	Other fuel combustion
JM	1994	8.20		2.25	4.11	1.26	0.59
SR	1981						
	1983						
	1985						
	1987						
	1989						
	1991						
	1993						
	1995						
	1997						
TT	1990 ^a	9.9		3.7			
	1996 ^b			2.1	8.0	1.4	0.2
	2000 ^c						

AIR5: EMISSIONS OF METHANE (CH₄)**H****Concept and Definition**

This is the total anthropogenic methane (CH₄) emissions from the sectors energy, industrial processes, solvent and other product use, agriculture, land use change and forestry, and waste. Natural emissions are not accounted for in this indicator. The unit of measurement is tonnes CH₄ per year. CH₄ is a powerful greenhouse gas whose levels have already doubled. The main purpose of this indicator is to monitor total anthropogenic CH₄ emissions.

The indicator is linked to the indicators of other greenhouse gases. Furthermore, the indicator is linked with those in the area of Ozone Depletion. CH₄ emissions are believed to affect stratospheric ozone depletion. Moreover, ozone is also a greenhouse gas, and therefore changes in stratospheric ozone should be considered in assessing climate change.

The main sources of CH₄ are agriculture (mainly flooded rice paddies and livestock), waste dumps, coal mining and natural gas production and transportation. CH₄ is besides a direct greenhouse gas also a precursor of tropospheric ozone and stratospheric water vapour.

The *radiative forcing capacity* (RF) is the amount of energy per unit area per unit time, absorbed by the greenhouse gas, that would otherwise be lost to space.

Please refer to AIR2 for definitions of selectable source categories.

Method of Computation

The 1996 “Guidelines for National Greenhouse Gas Inventories” have been formally adopted by the IPCC as the international method to estimate emissions.

Indicator Relevance

Although total CH₄ emissions are relatively small compared with total CO₂ emissions, the radiative forcing capacity of CH₄ is relatively large. Methane, the primary component of natural gas, accounts for 16 percent of all greenhouse-gas emissions resulting from human activities. It is 23 times as effective at trapping heat in the atmosphere as carbon dioxide and has a relatively short atmospheric lifetime of approximately 12 years. This makes methane-emissions reductions particularly effective at mitigating global warming in the near term. Capturing methane emissions and using them as a clean energy source can also increase energy security, enhance economic growth, improve local air quality and industrial safety. <http://www.esrl.noaa.gov/research/themes/forcing/Methane.pdf>

Data Assessment

All reporting Member States followed the internationally recommended definitions for emissions of methane (CH₄). This indicator is, therefore, regionally and internationally conceptually harmonized.

Only Jamaica and Trinidad and Tobago reported data on this indicator of the reporting eighteen Member States/Associate Members of the Community.

Data Sources

In accordance with the decision that the UNSD would provide data on waste, water, land, and air to the CARICOM Secretariat, data for this indicator was collected through the UNSD.

Please refer to **Appendix 1.10.5 (a)** for the original sources of the data, as specified by the UNSD, on air for Member States and Associate Members.

Evaluation

Due to the limited availability of quantitative data, no analysis will be presented.

Table 10.5 (a) - Emissions of Methane (CH₄): 1990 and 1994

(1000 t)

Country	Year	TOTAL emissions	TOTAL Energy activities	Industrial processes	Solvent use	Agriculture	Other sources of emissions
JM	1994		0.68				
TT	1990 ^a	32.75	1.4	0.8		6.3	24.2

Table 10.5 (b) - Emissions of Methane (CH₄): 1990 and 1994

(1000 t)

Country	Year	TOTAL Energy activities	Total fugitive emissions from fuels	Total fuel combustion			
				Energy industries	Manufacturing industries and construction	Transport	Other fuel combustion
JM	1994	0.68	0.02	0.08	0.12	0.39	0.07
TT	1990 ^a	1.4	0.05				

AIR6: EMISSIONS OF NITROUS OXIDE (N₂O)**Concept and Definition**

Total anthropogenic nitrous oxide (N₂O) emissions from the sectors energy, industrial processes, solvent and other product use, agriculture, land use change and forestry, and waste. Natural emissions are not accounted for in this indicator. The unit of measurement is tonnes N₂O per year. The indicator is linked to the indicators of other greenhouse gases. Furthermore, the indicator is linked with those in the area of Ozone Depletion. Due to the long lifetime of N₂O, N₂O emissions can reach the stratosphere and affect the destruction of the ozone layer.

Moreover, ozone is also a greenhouse gas, and therefore changes in stratospheric ozone should be considered in assessing climate change. The main sources of anthropogenic N₂O are intensive agriculture using high levels of fertilisers, and a number of industrial processes. Natural sources are poorly quantified, but are probably twice as large as anthropogenic sources. Natural emissions are not accounted for in this indicator.

The *radiative forcing capacity* (RF) is the amount of energy per unit area per unit time, absorbed by the greenhouse gas, that would otherwise be lost to space.

Please refer to AIR2 for definitions of selectable source categories.

Method of Computation

The 1996 “Guidelines for National Greenhouse Gas Inventories” have been formally adopted by the IPCC as the international method to estimate emissions of Nitrous Oxide.

Indicator Relevance

N₂O is one of the major greenhouse gases. The main purpose of this indicator is to monitor total anthropogenic N₂O emissions. Although total N₂O emissions are relatively small in comparison with total CO₂ emissions, the radiative forcing capacity of N₂O is relatively large.

Data Assessment

All reporting Member States followed the internationally recommended definitions for air and emissions of nitrous oxide (N₂O). This indicator is, therefore, regionally and internationally conceptually harmonized.

Jamaica and Trinidad and Tobago were the only member states to provide data on this indicator.

Data Sources

In accordance with the decision that the UNSD would provide data on waste, water, land, and air to the CARICOM Secretariat, data for this indicator was collected through the UNSD.

Please refer to **Appendix 1.10.6 (a)** for the original sources of the data, as specified by the UNSD, on waste of Member States and Associate Members.

Evaluation

Due to the limited availability of quantitative data, no analysis will be presented.

Table 10.6 (a) - Emissions of Nitrous Oxide (N₂O): 1990 and 1994

(1000 t)

Country	Year	TOTAL emissions	TOTAL Energy activities	Industrial processes	Solvent use	Agriculture	Other sources of emissions
JM	1994		0.11	0			
TT	1990 ^a	0.82	0.04			0.7	0.08

Table 10.6 (b) - Emissions of Nitrous Oxide (N₂O): 1990 and 1994

(1000 t)

Country	Year	TOTAL Energy activities	Total fugitive emissions from fuels	Total fuel combustion			
				Energy industries	Manufacturing industries and construction	Transport	Other fuel combustion
JM	1994	0.11	0	0.02	0.03	0.01	0.05
TT	1990 ^a	0.04					

AIR7: TOTAL EMISSIONS OF LEAD (Pb) AND CONSUMPTION OF LEADED PETROL**H****Concept and Definition**

Total consumption of gasoline and diesel oil by all categories of road vehicles i.e. passenger vehicles, light duty vehicles, trucks, lorries, buses and motorcycles, must be recorded on an annual basis. The unit of measurement is Kt of gasoline and diesel oil per year. The quantity of petroleum products consumed for road transportation is directly related to the vehicle ownership rate and gives an indication of the driving habits as well as the economic evolution for any country. As an observation, it can be noted that public transport means are used to a larger extent in the developing than in the developed countries around the world.

Measurement

Total amounts of gasoline and diesel oil used for road transportation are readily available from local as well as regional and international organisations (e.g. IEA, EUROSTAT). These fuel quantities have to be disaggregated into specific amounts for each vehicle category. This can be achieved by considering the composition of the vehicles fleet (categories must be identified by age and technology used) and specific consumption rates. Further information must also be selected referring to driving patterns and specifically to the mileage for the transportation of both persons and goods within the boundaries of the country.

Indicator Relevance

The road transportation sector is one of the major contributors of emissions of air pollutants in the atmosphere, such as NO_x, NMVOC (combustion and fugitive emissions), CO₂ and other compounds. The main purpose of this indicator is to monitor the amount of emissions of lead due to its potential and proven carcinogenic effect.

In the last few years, it has become apparent that present consumption patterns can not be sustained in the long term. Recently, the automobile industry in collaboration with local governments - under a series of (voluntary) agreements - has taken a number of steps towards the improvement of fuel efficiency of all new road vehicles in the market. Furthermore, fuel switching is also currently being promoted with the use of liquefied petroleum gas and natural gas as alternative fuels for buses and/or passenger vehicles.

Data Assessment

All reporting Member States followed the internationally recommended definitions for the consumption of leaded petrol. This indicator is, therefore, regionally and internationally conceptually harmonized.

Jamaica and Trinidad and Tobago were the only member states to provide data on this indicator.

Data Sources

In accordance with the decision that the UNSD would provide data on waste, water, land, and air to the CARICOM Secretariat, data for this indicator was collected from the UNSD instead of from Member States and Associate Members.

Please refer to **Appendix 1.10.7 (a)** for the original sources of the data, as specified by the UNSD, on air of Member States and Associate Members.

Evaluation

Jamaica's total consumption of leaded petrol declined for the period 1995 to 2001 more so from 1997 whilst its consumption of lead-free petrol increased for the same period. This is as a result Jamaica's policy to phase out leaded petrol on the island since 1997. This caused an initial 17 per cent decline in consumption of lead petrol from 1997 to 1998 and a 31 per cent increase in the consumption of lead-free petrol. Trinidad and Tobago's emissions of lead from mobile sources totalled 0.05 thousand tonnes while emissions of lead from stationary sources totalled 0.02 thousand tonnes in 1996.

Table 10.7 - Emissions of Lead (Pb) and Consumption of Leaded Petrol: 1995-2002

(1000 barrels and 1000 t)

Country	Year	Total mobile sources	Total stationary sources	Total emissions	Total consumption of leaded petrol	Total consumption of lead-free petrol
JM	1995	...	...	...	1862.2	1150.6
	1996	...	...	...	1982.1	1578.3
	1997	...	...	...	1901.2	1828.3
	1998	...	...	...	1581.8	2397.0
	1999	...	...	...	1296.8	2793.0
	2000	...	...	...	374.0	3790.5
	2001	...	...	...	4.8	4162.8
	2002 ^p	...	...	...	0.0	4523.3
TT	1996 ^a	0.05	0.02	0.07		

Addendum

Air emissions predominantly arise from the combustion of fossil fuels, mainly from transport activities, power plants, refineries and other kinds of fuel combustion activities. These activities generate a large variety of air pollutants of which carbon dioxide (CO₂), sulphur dioxide (SO₂), nitrogen oxides (NO_x) and non-methane volatile organic compounds (NM-VOCs) are among the most significant ones. Industrial processes and agriculture also contribute to the emissions of the above-mentioned pollutants as well as to emissions of other greenhouse gases such as nitrous oxide (N₂O) and methane (CH₄). Transport and the metal industry are the main sources of lead (Pb) emissions. Transport and energy production facilities are furthermore the main factors affecting ambient air quality in cities.

DEFINITIONS

Total emissions refer to Emissions from human activities in the country. Please note that emissions from international aviation and maritime transport are excluded.

Energy activities [Production and Use] comprise all emissions related to the production and use of energy in any sectors of the economy and households. It includes emissions from fuel combustion as well as fugitive fuels. This variable corresponds to IPCC category 1.

Fuel combustion: Emissions caused by the burning of fossil fuels in any process. It comprises the combustion of fuels in the energy industries, all other industries and transport; it includes small combustion activities such as in commercial, institutional or residential buildings, fuel combustion in agriculture and in all other activities. CO₂ emission from the combustion of biomass is excluded. This variable corresponds to IPCC category 1A.

Energy industries: Emissions from fuel combustion in public electricity and heat production, in petroleum refining, manufacturing of solid fuels and other energy industries. For the purposes of this questionnaire, fugitive emissions from fuels (coal mining, oil and gas fields, venting and flaring etc.) are not allocated to this category. Please note that evaporative emissions from vehicles are included under Transport. This variable corresponds to IPCC category 1A1.

Manufacturing industries and construction: Emissions from fuel combustion in manufacturing industries (except coke ovens that are allocated under Energy industries) and construction. If more disaggregated data by industrial activities according to International Standard Industrial Classification of All Economic Activities (ISIC)/Revision 3 are available, please provide them in the Supplementary Information Sheet. This variable corresponds to IPCC category 1A2.

Transport: Emissions from fuel combustion in transport activities such as domestic air transport, road transport, railways, navigation and other transport. Evaporative emissions from vehicles are also included in this category. Please note that emissions from international aviation and marine transport are excluded. If separate data on emissions from road transport are available, please provide them in the Supplementary Information Sheet. This variable corresponds to IPCC category 1A3.

Other fuel combustion: Emissions from fuel combustion in commercial, institutional and residential buildings, agriculture, forestry, fishing and other non-specified fuel combustion (e.g. military). The fishing sector includes domestic inland, coastal and deep-sea fishing. This variable corresponds to the sum of the IPCC categories 1A4 and 1A5.

Fugitive emissions from fuels: Intentional or unintentional releases of gases from anthropogenic activities. In particular, they may arise from the production, processing, transmission, storage and use of fuels, and include emissions from combustion only where it does not support a productive activity (e.g., flaring of natural gases at oil and gas production facilities). The variable corresponds to the sum of the IPCC categories 1B1 and 1B2.

Industrial processes: Emissions from processes such as chemical industry, metal industry, production and use of mineral products and other industries. If more disaggregated data according to ISIC/Rev.3 are available, please provide them in the Supplementary Information Sheet. This variable corresponds to IPCC category 2.

Solvent use: Emissions from paint application, degreasing and dry cleaning, manufacturing and processing of chemical products, and other processes using solvents and other solvent based products. This variable corresponds to IPCC category 3.

Agriculture: Emissions from the breeding of livestock, rice cultivation, field burning of agricultural residues, prescribed burning of savannas and other agricultural activities. This variable corresponds to IPCC category 4.

Other sources of Emissions: Emissions from waste water treatment, waste disposal on land, waste incineration, land-use changes, forestry and other activities which have not been covered above. This variable corresponds to the sum of the IPCC categories 5, 6 and 7.

Non-methane volatile organic compounds (NM-VOCs): A group of solvent-like organic compounds that easily evaporate at normal temperatures. They are produced mainly in fuel combustion and in processes that use solvents or solvent-based products such as painting, metal degreasing etc. Several of these chemicals are harmful to human health if inhaled, ingested, drunk or get in contact with skin. NM-VOCs are significant precursors to ground level ozone formation. NM-VOCs are the sum of all hydrocarbon air pollutants except methane.

Appendix 1.10

1.10.1 (a): Sources of Data for Tables 10.1 (a) and (b) - Emissions of Sulphur Dioxide (SO₂): 1990, 1994 and 1996

Country	Data Source
JAMAICA	Statistical Institute of Jamaica
TRINIDAD AND TOBAGO	EMA (Environmental Management Authority)

1.10.2 (b): Notes for Tables 10.1 (a) and (b) - Emissions of Sulphur Dioxide (SO₂): 1990, 1994 and 1996

Country	Notes
JAMAICA	a - Energy activities and industrial processes only
TRINIDAD AND TOBAGO	a - Source: EMA (2001). Initial National Communication of the Republic of Trinidad and Tobago under the UNFCCC b - Refers to emissions from fuel combustion in energy industries, industry, and transport, plus industrial processes. c - Refers to emissions from fuel combustion in energy industries, industry, and transport only d - Partial estimates delivered using the WHO Rapid Assessment Methodology e - UNSD: Estimate

1.10.2 (a): Sources of Data for Tables 10.2 (a) and (b) - Emissions of Nitrogen Oxides (NO_x): 1975 - 1999

Country	Data Source
JAMAICA	Statistical Institute of Jamaica
TRINIDAD AND TOBAGO	EMA (Environmental Management Authority)

1.10.2 (b): Notes for Tables 10.2 (a) and (b) - Emissions of Nitrogen Oxides (NO_x): 1975 - 1999

Country	Notes
JAMAICA	a - Energy activities only
TRINIDAD AND TOBAGO	Estimates derived from applying the waste load factor from the WHO manual. Municipal waste figures are the annual estimated figures for the three waste sites managed by SWMCOL.

1.10.3 (a): Sources of Data for Tables 10.3 (a) and (b) - Emissions of Non-Methane Volatile Organic Compounds (NM-VOCs): 1990 and 1994

Country	Data Source
JAMAICA	Statistical Institute of Jamaica
TRINIDAD AND TOBAGO	EMA (Environmental Management Authority)

1.10.3 (b): Notes for Tables 10.3 (a) and (b) - Emissions of Non-Methane Volatile Organic Compounds (NM-VOCs): 1990 and 1994

Country	Notes
JAMAICA	a - Energy activities and industrial processes only
TRINIDAD AND TOBAGO	Source: EMA (2001). Initial National Communication of the Republic of Trinidad and Tobago under the UNFCCC

1.10.4 (a): Sources of Data for Tables 10.4 (a) and (b) - Emissions of Carbon Dioxide (CO₂): 1981-2000, various years

Country	Data Source
JAMAICA	Statistical Institute of Jamaica
TRINIDAD AND TOBAGO	EMA (Environmental Management Authority)

1.10.4 (b): Notes for Tables 10.4 (a) and (b) - Emissions of Carbon Dioxide (CO₂): 1981-2000, various years

Country	Notes
TRINIDAD AND TOBAGO	a - Source: EMA (2001). Initial National Communication of the Republic of Trinidad and Tobago under the UNFCCC b - Partial estimate delivered using the WHO Rapid Assessment Methodology - Source: UNDP/EMA (1998) Pollutant Inventory Study for Trinidad & Tobago c - Source: 2003 Edition CO ₂ Emissions From Fuel Combustion 1971-2001, IEA Statistics d - Emissions from fuel combustion only

1.10.5 (a): Sources of Data for Tables 10.5 (a) and (b) - Emissions of Methane (CH₄): 1990 and 1994

Country	Data Source
JAMAICA	Statistical Institute of Jamaica
TRINIDAD AND TOBAGO	EMA (Environmental Management Authority)

1.10.5 (b): Notes for Tables 10.5 (a) and (b) - Emissions of Methane (CH₄): 1990 and 1994

Country	Notes
TRINIDAD AND TOBAGO	a - Source: EMA (2001). Initial National Communication of the Republic of Trinidad and Tobago under the UNFCCC

1.10.6 (a): Sources of Data for Tables 10.6 (a) and (b) - Emissions of Nitrous Oxide (N₂O): 1990 and 1994

Country	Data Source
JAMAICA	Statistical Institute of Jamaica
TRINIDAD AND TOBAGO	EMA (Environmental Management Authority)

1.10.6 (b): Notes for Tables 10.6 (a) and (b) - Emissions of Nitrous Oxide (N₂O): 1990 and 1994

Country	Notes
JAMAICA	p - preliminary data
TRINIDAD AND TOBAGO	Source: EMA (2001). Initial National Communication of the Republic of Trinidad and Tobago under the UNFCCC

1.10.7 (a): Sources of Data for Table 10.7 - Emissions of Lead (Pb) and Consumption of Leaded Petrol: 1995 - 2002

Country	Data Source
JAMAICA	Statistical Institute of Jamaica
TRINIDAD AND TOBAGO	EMA (Environmental Management Authority)

1.10.7 (b): Notes for Table 10.7 - Emissions of Lead (Pb) and Consumption of Leaded Petrol: 1995 - 2002

Country	Notes
JAMAICA	p - preliminary data
TRINIDAD AND TOBAGO	a - Partial estimates delivered using the WHO Rapid Assessment Methodology - Source: UNDP/EMA (1998) Pollutant Inventory Study for Trinidad and Tobago