

CARBON DIOXIDE EMISSIONS		
Atmosphere	Climate Change	Core indicator

## 1. INDICATOR

- (a) **Name:** Carbon dioxide (CO<sub>2</sub>) emissions.
- (b) **Brief Definition:** Anthropogenic emissions, less removal by sinks, of carbon dioxide (CO<sub>2</sub>). In addition to total emissions, sectoral CO<sub>2</sub> emissions can be considered. The typical sectors for which CO<sub>2</sub> emissions/removals are estimated are energy, industrial processes, agriculture, waste, and the sector of land use, land-use change and forestry (LULUCF).
- (c) **Unit of Measurement:** Annual CO<sub>2</sub> emissions in gigagrams (Gg).
- (d) **Placement in the CSD Indicator Set:** Atmosphere/Climate Change.

## 2. POLICY RELEVANCE

(a) **Purpose:** This indicator measures the emissions of carbon dioxide which is known to be the most important, in terms of impact on global warming, anthropogenic greenhouse gas (GHG).

(b) **Relevance to Sustainable/ Unsustainable Development (theme/sub-theme):** For about a thousand years before the industrial revolution, the amount of greenhouse gases in the atmosphere remained relatively constant. Since then, the concentration of various greenhouse gases has increased. The amount of carbon dioxide has increased by more than 30% since pre-industrial times and is currently increasing at an unprecedented rate of about 0.4% per year, mainly due to the combustion of fossil fuels and deforestation.

Since the late nineteenth century, the mean global temperature has increased by 0.4-0.8°C and the sea level has risen by 10 to 15cm. A doubling of the CO<sub>2</sub> concentration in the atmosphere is believed to cause an increase in the global mean temperature of 1.5 to 4.5°C. To appreciate the magnitude of this temperature increase, it should be compared with the global mean temperature difference of perhaps 5 to 6°C from the middle of the last ice age to the present interglacial period.

(c) **International Conventions and Agreements:** The United Nations Framework Convention on Climate Change entered into force in March 1994 and as of 11 April 2007 has received 191 instruments of ratification or accession. The Kyoto Protocol to the Convention was adopted in December 1997 and entered into force on 16 February 2005. As of 6 June 2007, the Kyoto Protocol has received 174 instruments of ratifications, accessions, approvals or acceptances.

(d) **International Targets/Recommended Standards:** The Climate Change Convention includes a commitment by developed country Parties (Annex I Parties),

including economies in transition, to aim to return emissions of CO<sub>2</sub> and other GHGs not controlled by the Montreal Protocol to their 1990 levels by 2000. This was achieved: in 2000, GHG emissions from Annex I Parties were about 6 per cent below the 1990 level. The Kyoto Protocol sets individual emission reduction targets for Annex I Parties (developed countries, including countries with economies in transition), which should lead to an overall reduction in GHG emissions from developed countries by at least 5 per cent below the 1990 level in the first commitment period 2008 to 2012. Carbon dioxide amounts to about 80 per cent of total GHG emissions and therefore changes in CO<sub>2</sub> emissions determine, to a sizable extent, the trend for total GHG emissions.

The indicator is also used to measure progress towards the Millennium Development Goal Nr. 7 (Ensure environmental sustainability) and the associated target "Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources"

**(e) Linkages to Other Indicators:** This indicator is linked to many other socio-economic and environmental indicators, including GDP growth rate, energy consumption, environmental protection expenditures, and expenditures on air pollution abatement. Of particular relevance is the link to the CSD GHG indicator and to the CO<sub>2</sub> per capita indicator within the framework of the Millennium Development Goals (MDG).

### 3. METHODOLOGICAL DESCRIPTION

**(a) Underlying Definitions and Concepts:** Greenhouse gases contribute in varying degrees to global warming depending on their heat absorptive capacity and their lifetime in the atmosphere. The global warming potential (GWP) describes the cumulative effect of a gas over a time horizon (usually 100 years) compared to that of CO<sub>2</sub>. For example, according to the IPCC Second Assessment Report, 1995, the global warming potential of CH<sub>4</sub> (methane) is 21, meaning that the global warming impact of one kg of CH<sub>4</sub> is 21 times higher than that of one kg of CO<sub>2</sub>. However, although the GWP values for methane is higher than for carbon dioxide, the volume of emissions is much greater for CO<sub>2</sub>.

**(b) Measurement Methods:** CO<sub>2</sub> emissions are estimated from data on emission sources, which are mostly facilities where fuel is combusted to produce energy. Data on the amount of fuel used and emission factors for each source are applied in the estimates.

**(c) Limitations of the Indicator:** Carbon dioxide is only one of greenhouse gases and therefore CO<sub>2</sub> emissions are smaller than the overall GHG emissions. Data for developed countries, including economies in transition, are more complete and easier available than data for developing countries.

**(d) Status of the Methodology:** Developed country Parties to the Convention have been reporting CO<sub>2</sub> data as part of their GHG data submissions since 1994. The IPCC has published two sets of guidelines on methodologies for the estimation of GHG

inventories and further elaborated this with guidance on good practice in 2000 and another guidance for land use, land-use change and forestry in 2003.

**(e) Alternative Definitions/Indicators:** CO<sub>2</sub> emissions can alternatively be measured on a gross instead of net basis in which case no account is taken of removal by sinks. CO<sub>2</sub> emissions can be also assessed on the per capita basis or per GDP basis, as in indicator 28 (a) of the MDG indicators “CO<sub>2</sub> emissions, total, per capita and per 1\$ GDP (PPP)”

#### **4. ASSESSMENT OF DATA**

**(a) Data Needed to Compile the Indicator:** Greenhouse gas emissions data.

**(b) National and International Data Availability and Sources:** National communications from Parties to the Climate Change Convention, including both developed and developing countries, are available. In addition, developed countries submit their detailed GHG inventories, including CO<sub>2</sub> data, to the UNFCCC secretariat annually. At the international level, the UNFCCC Secretariat supports a database with GHG data based on annual data inventory submissions from developed countries and periodic submissions of national communications from developing countries.

**(c) Data References:**

GHG data section at the UNFCCC website ([http://unfccc.int/ghg\\_emissions\\_data/items/3800.php](http://unfccc.int/ghg_emissions_data/items/3800.php))

CO<sub>2</sub> data at the IEA website ([www.iea.org](http://www.iea.org))

The UN site on the Millennium Development Goals indicators (<http://mdgs.un.org>)

National greenhouse gas inventory data for the period 1990-2004 and status of reporting. UNFCCC document FCCC/SBI/2006/26 (available at <http://unfccc.int/resource/docs/2006/sbi/eng/26.pdf>)

National submissions of GHG inventories of Annex I Parties under the Climate Change Convention (available at [http://unfccc.int/national\\_reports/annex\\_i\\_ghg\\_inventories/national\\_inventories\\_submissions/items/3734.php](http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/3734.php))

#### **5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR**

**(a) Lead Agency:** The lead agency is the Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC). The contact point is the Executive Secretary, Secretariat, UNFCCC, fax no. (49-228) 815-1999.

**(b) Other Contributing Organizations:** The Intergovernmental Panel on Climate Change (IPCC develops methodological guidance for GHG emissions estimates). The International Energy Agency (IEA) supports a comprehensive database on CO<sub>2</sub> emissions from fuel combustion, including the data on CO<sub>2</sub>-related indicator.

#### **6. REFERENCES**

**(a) Readings:**

National greenhouse gas inventory data for the period 1990-2004 and status of reporting. UNFCCC document FCCC/SBI/2006/26 (available at <http://unfccc.int/resource/docs/2006/sbi/eng/26.pdf>)

UNFCCC reports on technical reviews of GHG inventories of developed countries ([http://unfccc.int/national\\_reports/annex\\_i\\_ghg\\_inventories/inventory\\_review\\_reports/items/3723.php](http://unfccc.int/national_reports/annex_i_ghg_inventories/inventory_review_reports/items/3723.php)).

UNFCCC reports on in-depth reviews of national communications of individual countries (available at [http://unfccc.int/national\\_reports/annex\\_i\\_natcom/idr\\_reports/items/2711.php](http://unfccc.int/national_reports/annex_i_natcom/idr_reports/items/2711.php)).

**(b) Internet sites:**

[unfccc.int](http://unfccc.int) (UNFCCC)

<http://www.un.org/climatechange/> (Gateway to the UN System's Work on Climate Change)

[www.iea.org](http://www.iea.org) (IEA)

[www.ipcc.ch](http://www.ipcc.ch) (IPCC)

[www.ipcc.nggip.iges.or.jp](http://www.ipcc.nggip.iges.or.jp) (IPCC technical support)