WORKING PAPER

WORLD RESOURCES INSTITUTE

World Greenhouse Gas Emissions in 2005

Tim Herzog

***World Greenhouse Gas Emissions in 2005* is a comprehensive view of global, anthropogenic greenhouse gas (GHG) emissions. The chart is an updated version of the original chart, which appeared in *Navigating the Numbers: Greenhouse Gas Data and International Climate Policy* (WRI, 2005).**

Suggested Citation: Herzog, Timothy. *World Greenhouse Gas Emissions in 2005*. WRI Working Paper. World Resources Institute. Available online at http://www.wri.org/publication/navigating-the-numbers.

July, 2009

Overview

One of the greatest challenges relating to global warming is that greenhouse gases result—directly or indirectly—from almost every major human industry and activity. This chart, "Global Greenhouse Gas Emissions in 2005," shows these industries and activities, and the type and volume of greenhouse gases that result from them. It includes emissions estimates from a range of international data providers, in an attempt to account for all significant GHG emissions sources.

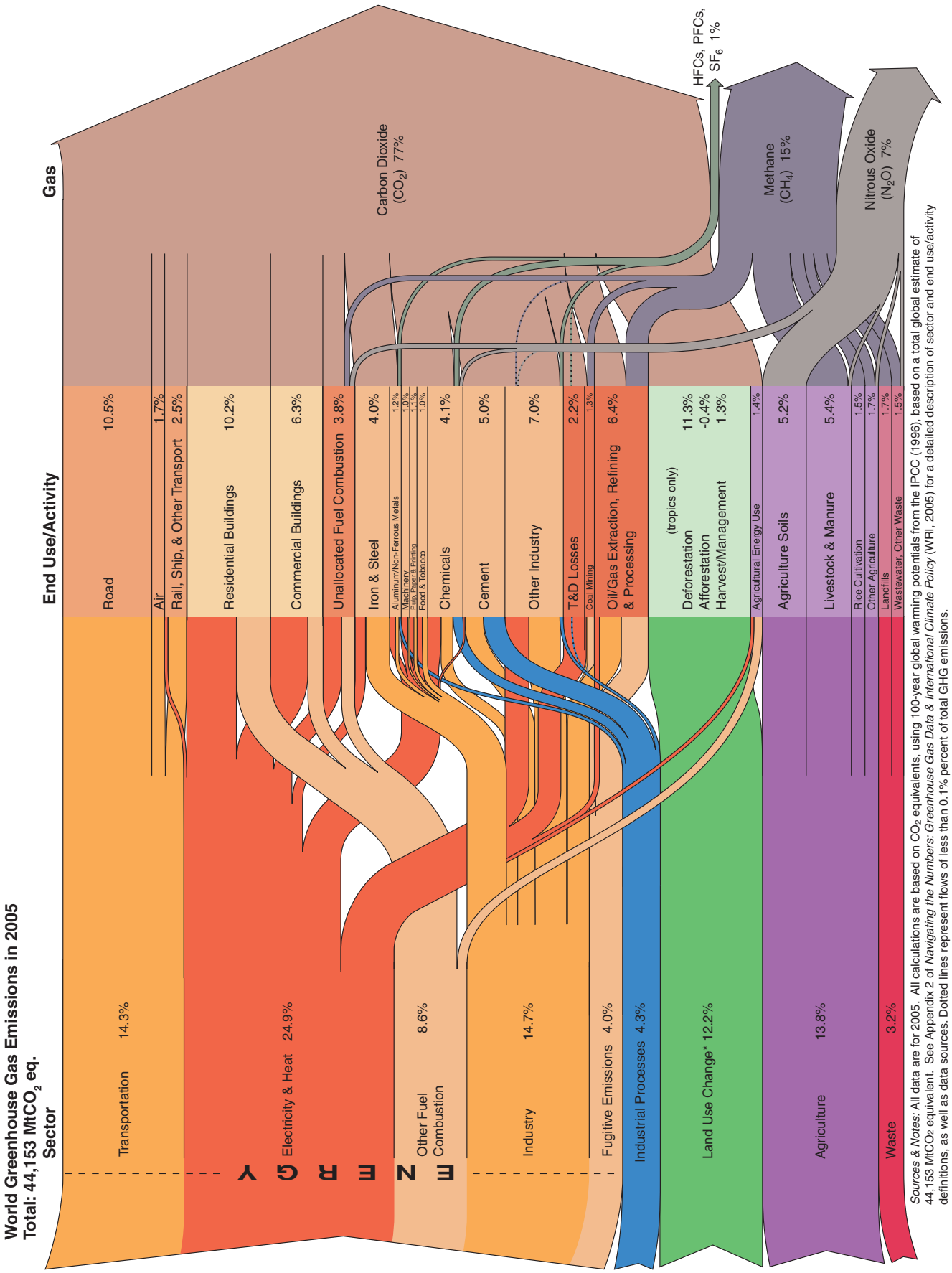
In 2005, total GHGs are estimated at 44,153 $MtCO_2$ equivalent (million metric tons). CO_2 equivalents are based on 100-year global warming potential (GWP) estimates produced by the IPCC. 2005 is the most recent year for which comprehensive emissions data are available for every major gas and sector.

Comparison to 2000

The original version of this chart appeared in *Navigating the Numbers: Greenhouse Gas Data and International Climate Policy* (WRI, 2005). The original chart used year 2000 data, the most recent year for which comprehensive data were available at the time.

Total global emissions grew 12.7% between 2000 and 2005, an average of 2.4% a year. However, individual sectors grew at rates between 40% and near zero, and there are substantial differences in sectoral growth rates between developed and developing countries.

The remainder of this paper discusses the most significant changes in the chart compared to its previous release.



Sources & Notes: All data are for 2005. All calculations are based on CO_2 equivalents, using 100-year global warming potentials from the IPCC (1996), based on a total global estimate of 44,153 $MtCO_2$ equivalent. See Appendix 2 of *Navigating the Numbers: Greenhouse Gas Data & International Climate Policy* (WRI, 2005) for a detailed description of sector and end use/activity definitions, as well as data sources. Dotted lines represent flows of less than 0.1% percent of total GHG emissions.

* Land Use Change includes both emissions and absorptions, and is based on analysis that uses revised methodologies compared to previous versions of this chart. These data are subject to significant uncertainties.

Land Use Change

In the latest chart, the most significant change (that is, the activity on the chart that grew or shrank the most) concerns the net contribution of atmospheric CO_2 from land-use change. These data (for both versions of the chart) come from research published by Woods Hole Research Center, which was revised in 2008. Revised rates of deforestation in the underlying Forest Resources Assessment (FRA) data produced significantly lower estimates of CO_2 from land use change compared to the previous research. As a result, CO_2 from land use change accounts for a significantly lower share of GHGs than in the original chart: 12.2% as compared to 18.2%.

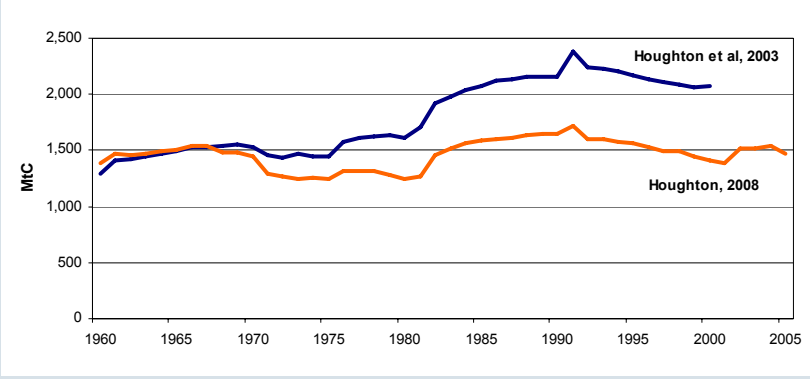
The apparent decrease is entirely due to revised methodologies used to calculate deforestation in the underlying FRA data, and not to any actual decrease in deforestation rates. **Chart 1** shows this distinction, in that the CO_2 estimates from the latter study are lower than those from the previous study for every year past 1970. Houghton's revised data actually shows that CO_2 emissions from land use change grew 4.1% between 2000 and 2005.

It should be further noted that estimates of CO_2 from land use change are still subject to large uncertainties. Studies cited by the IPCC 4th Assessment Report show error ranges of up to ±2,933 $MtCO_2$ (±0.8 GtC) at the global level in the 1990s (IPCC, 2007).

Energy Sectors

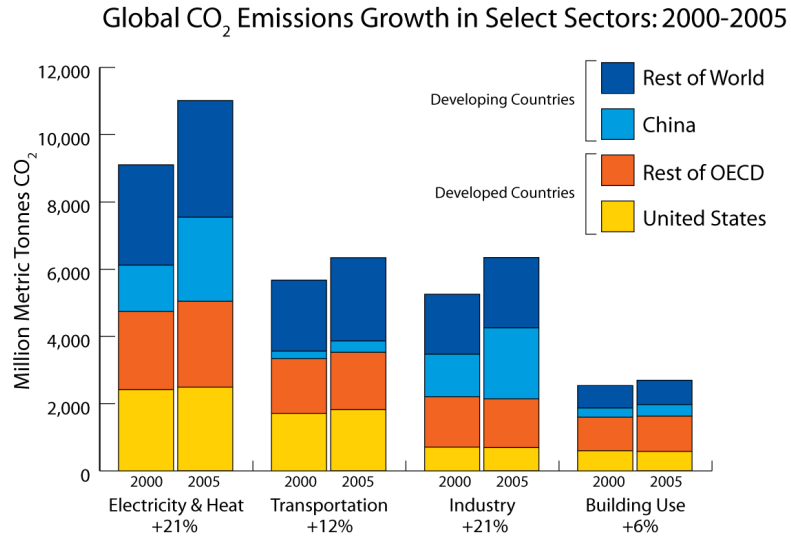
At the global level, emissions grew in almost every sector and end use between 2000 and 2005, the sole exception being the "Other Agriculture" category where growth was virtually flat. The most significant increases—in both absolute and relative terms—came from the power and transport sectors, as well as industry sub-sectors such as cement and iron & steel, which grew at 39% and 37% respectively.

Chart 1: Revisions to Estimates of Carbon Flux to the Atmosphere from Land Use Change



Sources: Houghton, 2003, Houghton, 2008.

Chart 2: Global CO_2 Emissions Growth in Select Sectors: 2000-2005



Sources: IEA, 2007, CDIAC, 2008. Emissions in transportation, industry and building use do not include grid electricity & heat attributed to those sectors. Emissions from industry do not include gas flaring or aluminum production.

Emissions growth is often dramatically different between developed and developing countries. **Chart 2** shows emissions growth by region in four select sectors: electricity & heat, transport, industry, and building use. Emissions growth in every sector is primarily attributable to developing countries, which now account for the majority of emissions from electricity & heat, as well as industry. However, developed countries still account for a majority of emissions in the transport and building use sectors.

Other Sectors

Growth in emissions of high global warming potential (GWP) gases is also noteworthy. This category includes several byproducts from the manufacture of use of industrial products and equipment. Emissions of this category of gases grew 44% between 2000 and 2005 on a CO_2-equivalent basis. The chief drivers of this growth are increasing electricity use (electricity transmission equipment produces sodium hexafluoride or SF_6 in trace amounts), and the manufacture of semiconductors and industrial chemicals, especially ODS substitutes. Growth in electricity use and semiconductor manufacturing is sharpest in developing countries. ODS substitute production is higher in developed countries, where ozone-depleting substances are being rapidly phased out under the Montreal Protocol (EPA, 2006).

Even with rapid growth, high GWP gases still account for a small percentage of global GHG emissions on a CO_2-equivalent basis. However, their significance stems from the fact that they are thousands of times more potent than CO_2.

Data Sources

The chart includes emissions estimates from several data providers, as shown in **Table 2**. With the exception of Aluminum process emissions, all of these sources are included in the 6th edition of WRI's Climate Analysis Indicators Tool (http://cait.wri.org). For additional discussion of sectors and methodologies, see the appendices of *Navigating the Numbers: Greenhouse Gas Data and International Climate Policy* (WRI, 2005).

Table 1: Data Sources

Publication/Agency	Gases[1]	Sectors/Activities
CO_2 Emissions from Fossil Fuel Combustion (IEA, 2007).	CO_2	Energy use (all sectors)
Global, Regional, and National Fossil Fuel CO2 Emissions (CDIAC, 2008)	CO_2	Process emissions[2] from cement production
Carbon Flux to the Atmosphere from Land-Use Changes 1850-2005 (Houghton, RA. 2008)	CO_2	Land-use change
International Energy Annual (Energy Information Agency, U.S. DOE, 2008)	CO_2	Natural gas flaring
Historical Statistics for Mineral and Material Commodities in the United States (USGS)	CO_2	Process emissions from aluminum production (WRI estimate based on global production levels)
Global Anthropogenic Emissions of Non-CO2 Greenhouse Gases 1990-2020 (U.S. EPA, 2006)	CH_4, N_2O, HFCs, PFCs, SF_6	Stationary & mobile fuel combustion Coal mining Natural gas refining, processing, & distribution Industrial process emissions Agriculture Waste

[1] Major greenhouse gases and categories of GHGs are CO_2: carbon dioxide, CH_4: methane, N_2O: nitrous oxide, HFCs: hexaflourocarbons, PFCs: perflourocarbons, and SF_6: sodium hexaflouride

[2] Process emissions are those that are byproducts of the manufacturing processes of certain industrial goods, as opposed to the energy consumed to produce those goods.

References

Carbon Dioxide Information and Analysis Center (CDIAC). 2008. *Global, Regional, and National Fossil Fuel CO_2 Emissions.* http://cdiac.ornl.gov/trends/emis/tre_glob.html

U.S. Energy Information Agency. (EIA) 2008. *International Energy Annual.* http://www.eia.doe.gov/iea

U.S. Environmental Protection Agency (EPA). 2006. *Global Anthropogenic Emissions of Non-CO_2 Greenhouse Gases 1990-2020*. http://www.epa.gov/climatechange/economics/international.html#global_anthropogenic

Houghton, R.A. 2003. *Revised Estimates of the Annual Net Flux of Carbon to the Atmosphere From Changes in Land Use and Land Management 1850-2000.* Tellus 55B: 378-390.

Houghton, R.A. 2008. *Carbon Flux to the Atmosphere from Land-Use Changes 1850-2005*. http://cdiac.ornl.gov/trends/landuse/houghton/houghton.html

International Energy Agency (IEA). 2007. *CO_2 Emissions from Fossil Fuel Combustion.* http://www.iea.org/Textbase/publications/free_new_Desc.asp?PUBS_ID=1825

IPCC. 1996. *IPCC Guidelines for National Greenhouse Gas Inventories.* http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.html

Intergovernmental Panel on Climate Change (IPCC). 2007. *Climate Change 2007: Mitigation of Climate Change (Working Group III Report).* http://www.ipcc.ch/ipccreports/ar4-wg3.htm

United States Geological Service (USGS). *Historical Statistics for Mineral and Material Commodities in the United States*. http://minerals.usgs.gov/ds/2005/140

Baumert et al. 2005. *Navigating the Numbers: Greenhouse Gas Data and International Climate Policy.* World Resources Institute. http://www.wri.org/publication/navigating-the-numbers